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conspec

DEVELOPMENT OF AN INTRINSICALLY SAFE MINE MONITORING SYSTEM FOR USE IN COAL MINES

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CANMET

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Canada

Final Report
by

CONSPEC
Controls Limited

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DEVELOPMENT OF AN INTRINSICALLY SAFE MINE MONITORING SYSTEM FOR USE IN COAL MINES

BY

CONSPEC CONTROLS LIMITED

Work on this project was conducted under
the auspices of the Canada Centre for Mineral
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TABLE OF CONTENTS

PAGE

1. Introduction 1-1

PART I
SYSTEM DESCRIPTION

2. The Conspec Senturion 200 System 2-1

2.1 Record Keeping 2-1
2.2 Command Control 2-2
2.3 Hardware 2-3

2.3.1 Central Processor 2-3
2.3.2 Disk 2-3
2.3.3 Terminal 2-4
2.3.4 Data Event Printer 2-4
2.3.5 Communication Trunk Driver 2-4
2.3.6 Modems 2-5
2.3.7 FSK Modems 2-5
2.3.8 PSK Modems 2-6

2.4 Accessors 2-6

2.4.1 Binary Accessors 2-7
2.4.2 Analog Accessors 2-7
2.4.3 Pulse Input Accessors 2-8

3. Software 3-1

3.1 Application Software 3-1
3.2 Main Scan Program 3-2
3.3 Command Service 3-3
3.4 Alarm Printer Service 3-3
3.5 CRT Display Service 3-4
3.6 Event Sequencing 3-5

4. System Installation & Startup Procedure 4-1

4.1 Installation 4-1
4.2 Startup Procedure 4-3

PAGE

PART 2
INTRINSIC SAFETY APPROVAL

5. System Intrinsic Safety Evaluation 5-1

5.1 Identification of Components that require certification. 5-1

5.2 System Components Evaluation 5-2

- 5.2.1 Communication cable from surface 5-2
- 5.2.2 Modems And Associated Logic 5-3
- 5.2.3 Trunk Driver Circuits 5-3
- 5.2.4 Accessors 5-4
- 5.2.5 Accessor Trunk Cable 5-4
- 5.2.6 Power Supply 5-5
- 5.2.7 Instruments & Transducers 5-7

6. Final System Submitted To CANMET 6-1

- 6.1 Introduction 6-1
- 6.2 Conspec IS Power Supply P1166 6-1
- 6.3 Remote IS Trunk Driver Unit 6-2
- 6.4 Accessors 6-3
- 6.5 Accessor Trunk Cable 6-3
- 6.6 Instruments 6-4
- 6.7 Communication Line Barrier 6-5

LIST OF APPENDICES

APPENDIX A

SYSTEM DRAWINGS

APPENDIX B

ANALOG ACCESSOR CALCULATIONS

APPENDIX C

SAMPLE PRINTOUTS

APPENDIX D

SYSTEM COMMANDS SORTED BY FUNCTION

APPENDIX E

SUBMITTAL DOCUMENTS TO CANMET

APPENDIX F

DESCRIPTION OF CONSPEC I/S POWER SUPPLY P1166

APPENDIX G

TESTING AND REVIEW CORRESPONDENCE WITH CANMET

APPENDIX H

CANMET CERTIFICATE OF APPROVAL FOR FINAL SYSTEM

1. INTRODUCTION

Computerized systems offer many advantages to the mining industry, particularly in the use of its monitoring and control capabilities.

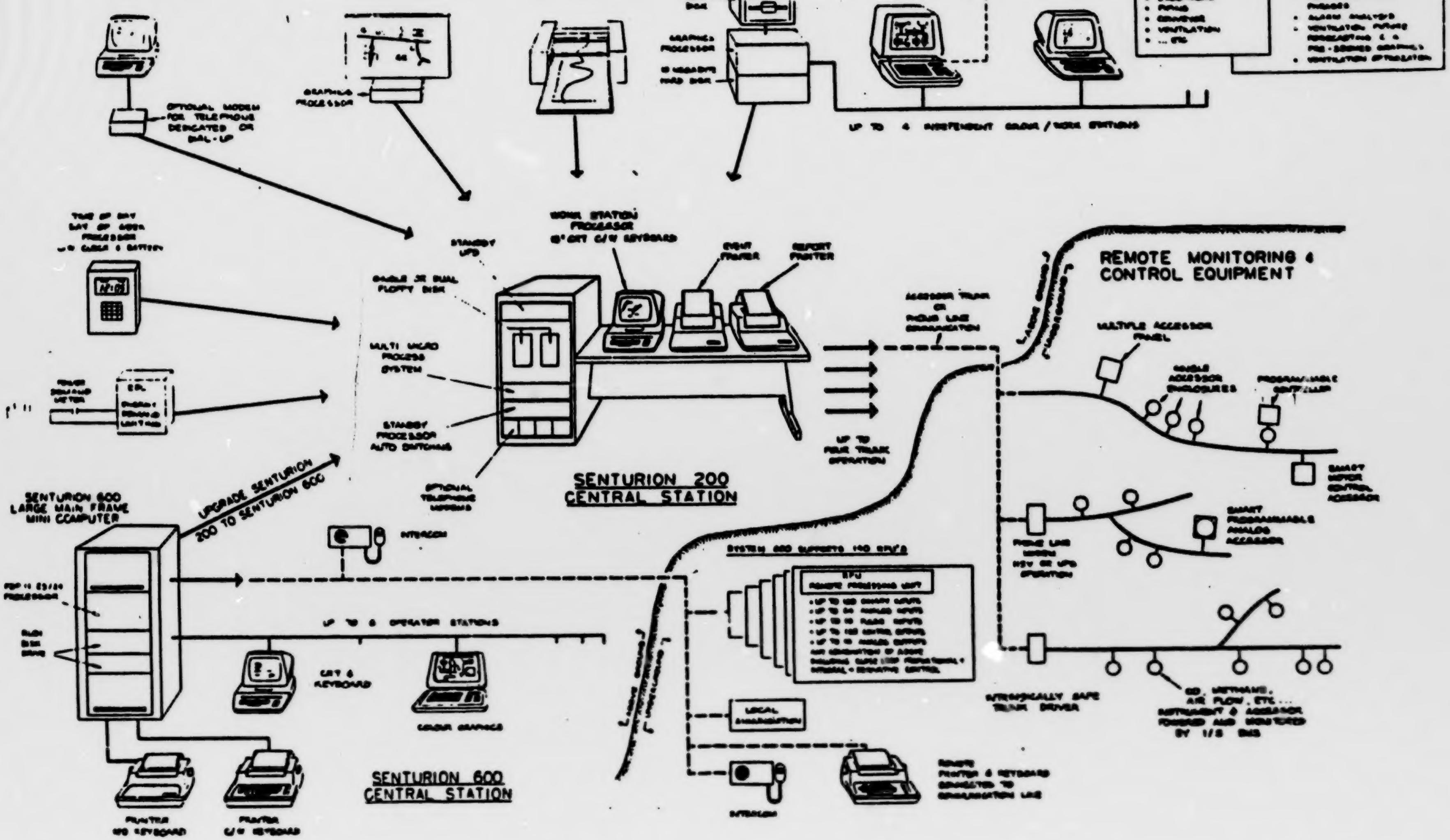
The Conspec Senturion 200 is a unique supervisory and command center, overseeing the operation of sub-systems and equipment within mines. The Senturion 200 is unique in that it requires only a four wire trunk over which it provides DC power as well as communications with all the field hardware. The field hardware comprises of a number of dedicated single (or multiple) point devices, called "accessors", which are capable of communicating directly with the central processor.

The system is designed for ease of installation and is completely field programmable by the operator. The use of English language keyboarding and a unique prompting system by the computer, eliminates the need for computer skilled personnel in the programming and operation of the system.

The supervisory capabilities of the machine include alarm reporting, sequential event recording, analog trending, field status reports, alarm summaries, etc. (A brochure illustrating the system is included on the following page). In addition a wide variety of add-on peripheral hardware for the front end is available for system capability expansion.

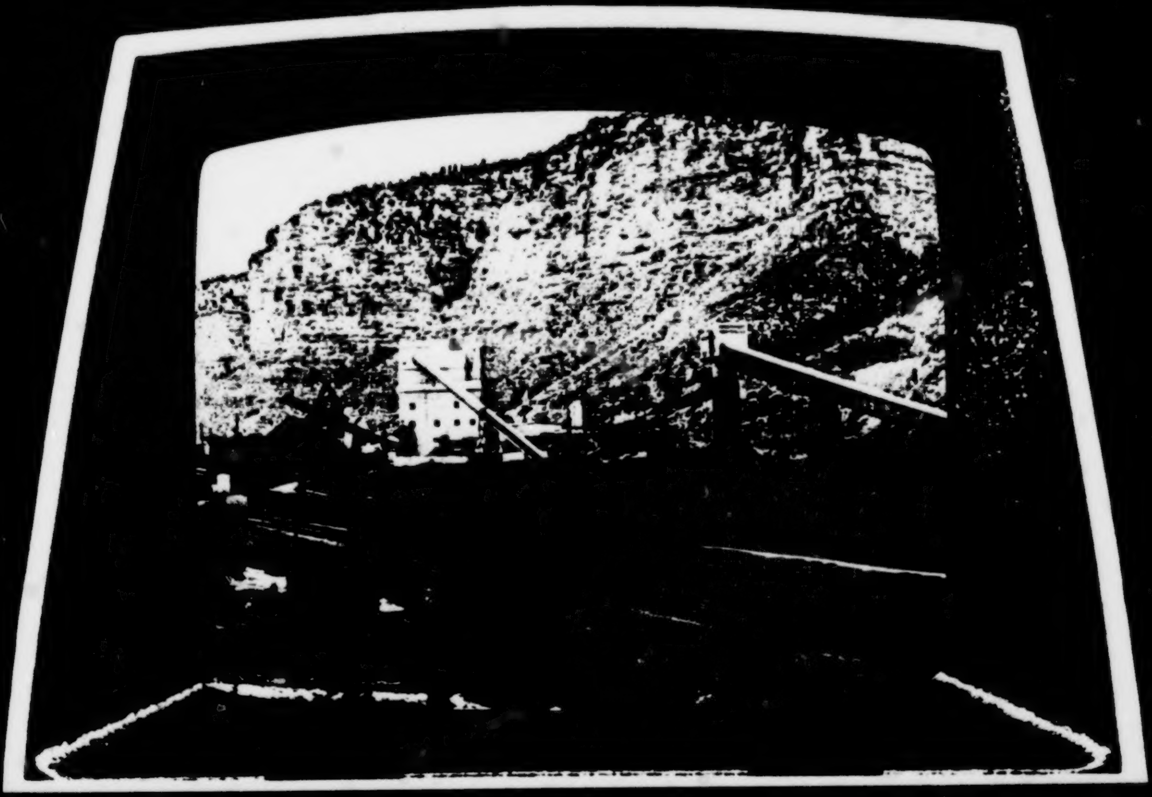
The Senturion 200 was developed by Conspec with initial funding provided by CANMET. The initial system was designed primarily for environmental monitoring. In order to make the system marketable to the mining community, Conspec further developed the system to expand the control and management reporting capabilities. This system, as developed, was suitable for use in hardrock mines. It was therefore necessary to modify and redesign some of the hardware in order to adapt the system to coal mines. The purpose of this report is to describe the necessary changes and modifications made to the system, in order to make it suitable for use in coal mines, as requested by CANMET contract.

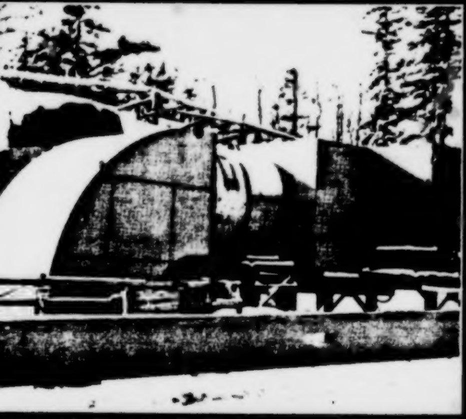
For completeness the first part of the report describes the Senturion 200 system, whilst the second part goes into the details of the changes and modifications made to the system.


OPTIONAL MODEM FOR TELEPHONE DEDICATED OR DIAL-UP
GRAPHICS PROCESSOR
GRAPHICS PROCESSOR
10 MEGABYTE HARD DISK
UP TO 4 INDEPENDENT COLOUR / WORK STATIONS
VENTILATION
... ETC
ALARM ANALYSIS
VENTILATION FUTURE
PRE-DEFINED GRAPHICS
VENTILATION OPTIMIZATION
TIME OF DAY
DAY OF WEEK
PROCESSOR
WITH CLOCK & BATTERY
POWER DEMAND METER
EPL
ENERGY DEMAND LIMITING
STANDBY UPS
SINGLE OR DUAL FLOPPY DISK
MULTI MICRO PROCESS SYSTEM
STANDBY PROCESSOR AUTO SWITCHING
OPTIONAL TELEPHONE MODEMS
WORK STATION PROCESSOR
12" CRT C/W KEYBOARD
EVENT PRINTER
REPORT PRINTER
UP TO FOUR TRUNK OPERATION
SENTURION 200
CENTRAL STATION
ACCESSOR TRUNK OR PHONE LINE COMMUNICATION
ABOVE GROUND
UNDERGROUND
REMOTE MONITORING &
CONTROL EQUIPMENT
MULTIPLE ACCESSOR PANEL
SINGLE ACCESSOR ENCLOSURES
PROGRAMMABLE CONTROLLER
SMART MOTOR CONTROL ACCESSOR
PHONE LINE MODEM
SMART PROGRAMMABLE ANALOG ACCESSOR
INTRINSICALLY SAFE TRUNK DRIVER
CO, METHANE, AIR FLOW, ETC...
INSTRUMENT & ACCESSOR POWERED AND MONITORED BY I/S BUS
SENTURION 600
LARGE MAIN FRAME
MINI CCMPUTER
UPGRADE SENTURION
200 TO SENTURION 600
INTERCOM
PDP 11 23/34 PROCESSOR
DISK DRIVE
UP TO 8 OPERATOR STATIONS
CRT & KEYBOARD
COLOUR GRAPHICS
PRINTER KEYBOARD
PRINTER C/W KEYBOARD
SENTURION 600
CENTRAL STATION
SYSTEM 600 SUPPORTS 140 RPU'S
RPU
REMOTE PROCESSING UNIT
LOCAL ANNUNCIATION
INTERCOM
REMOTE PRINTER & KEYBOARD CONNECTED TO COMMUNICATION LINE

conspec

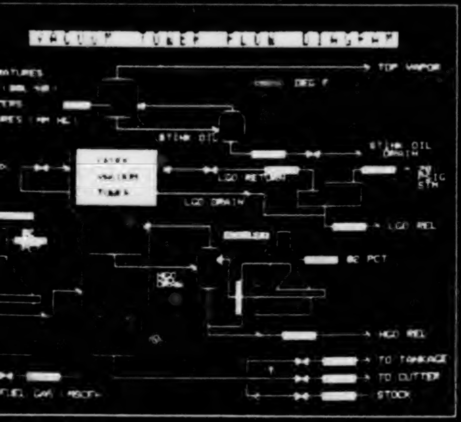
Control Monitoring and Plant Management Systems





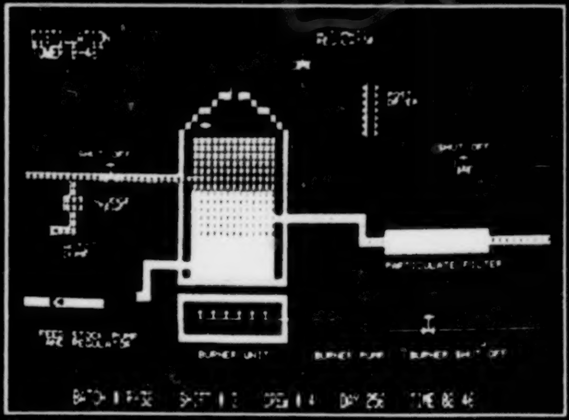
mental Control

range of instruments are available to continuous environmental monitoring tem detects fire, improper ventilation ardous conditions - protecting equipd personnel. All components are ally safe and can be used under e or corrosive conditions.


VACUUM TOWER FLOW DIAGRAM
TOP VAPOR
DEG F
STM OIL
STM OIL DRAIN
VACUUM TOWER
LGO RETURN
LGO DRAIN
LGO REL
HGO REL
TO TANKAGE
TO CUTTER
STOCK
FUEL GAS (ABSORB

### Shooting

matic trouble shooting routine equipment failures for speedy ance, reducing downtime.


ROOM
SHUT OFF
PARTICULATE FILTER
BURNER UNIT
BURNER PUMP
BURNER SHUT OFF
SHIFT # 3
DAY 256
TIME 08:46

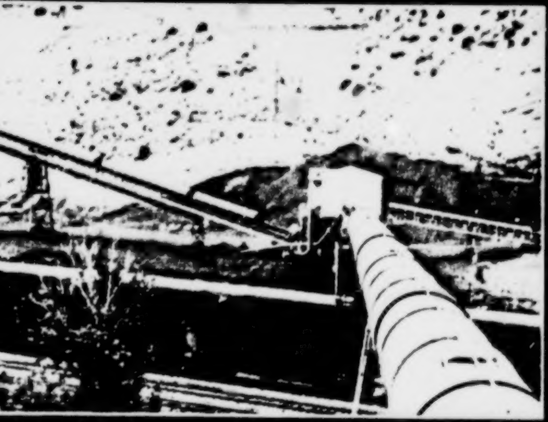
Color Graphic Display

Enhances the operator's understanding of the operation, improving maintenance and management reporting.

HIGH LEVEL ALARM
OVERLOAD OPEN
BROKEN MEDIA ALARM
ALARM ACKNOWLEDGE

Reports & Alarms

Interfaces easily to existing control panels and equipment for central monitoring.

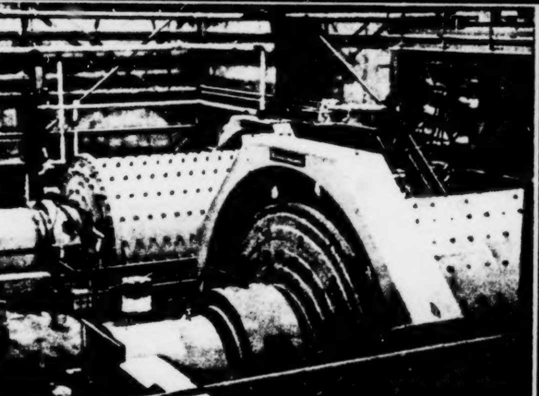


utomatic Equipment Sequencing

ommand Programming synchronizes uipment operation for maximum ficiency.

Cost Management

In order to remain competitive, more and more plants and mines are turning towards automation to maximize productivity. Through management of each individual aspect of the operation, the sum of all amounts saved can be translated into tremendous dollar value.



eventative Maintenance

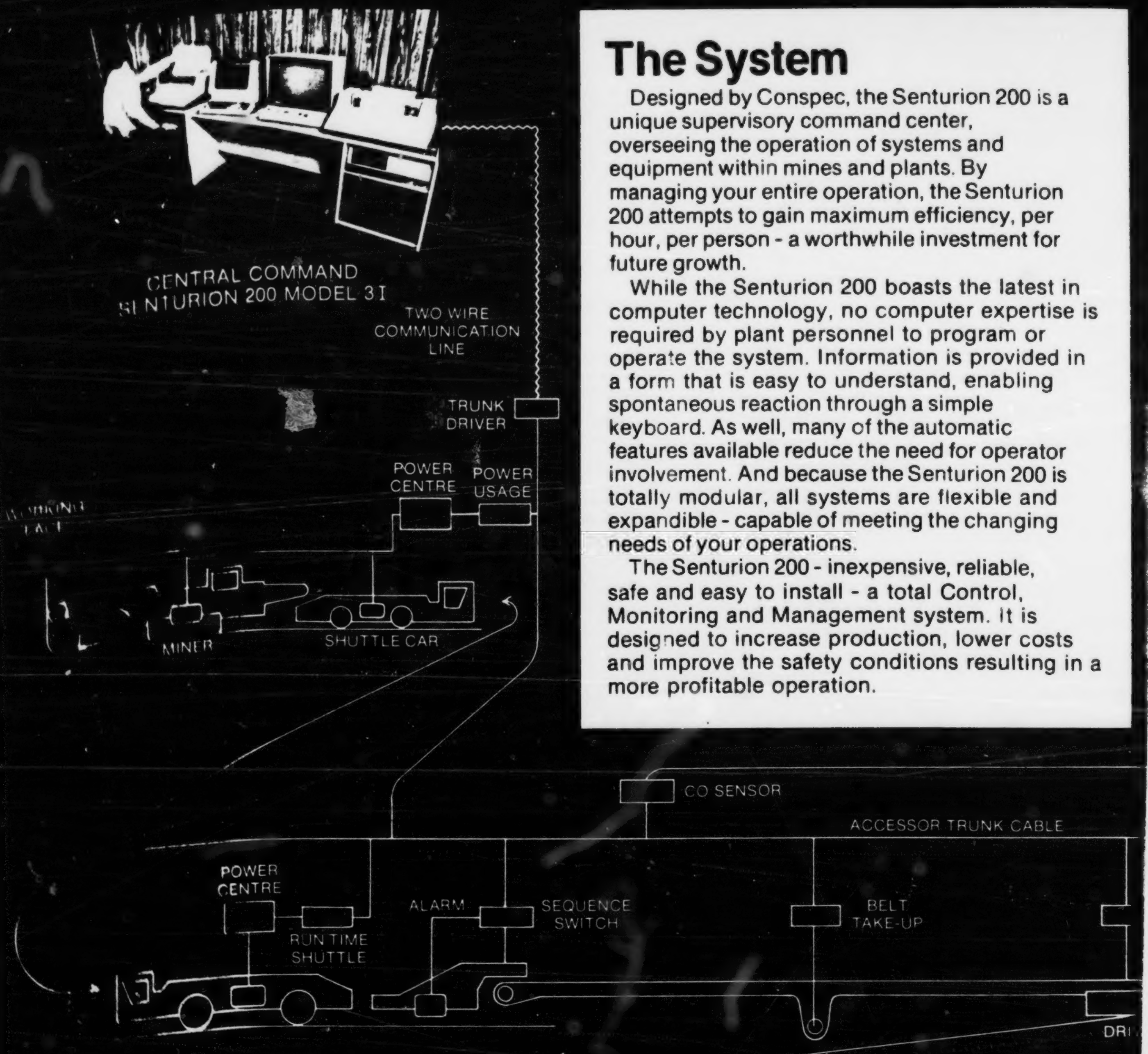
e identification of potential equipment lures in need of maintenance, heading-off stly major repairs and reducing downtime.

Energy Management

Scheduling of electrical loads - reducing 'demand peaks' and power consumption within the plant or mine.

Equipment Control Monitoring

The Senturion 200 system Controls and Monitors the status of operations, equipment and manpower.

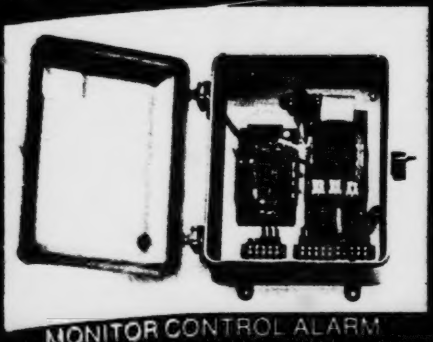

CENTRAL COMMAND
SENTURION 200 MODEL 31
TWO WIRE COMMUNICATION LINE
TRUNK DRIVER
POWER CENTRE
POWER USAGE
WORKING FACE
MINER
SHUTTLE CAR
CO SENSOR
ACCESSOR TRUNK CABLE
POWER CENTRE
RUN TIME SHUTTLE
ALARM
SEQUENCE SWITCH
BELT TAKE-UP
DRI

The System

Designed by Conspec, the Senturion 200 is a unique supervisory command center, overseeing the operation of systems and equipment within mines and plants. By managing your entire operation, the Senturion 200 attempts to gain maximum efficiency, per hour, per person - a worthwhile investment for future growth.

While the Senturion 200 boasts the latest in computer technology, no computer expertise is required by plant personnel to program or operate the system. Information is provided in a form that is easy to understand, enabling spontaneous reaction through a simple keyboard. As well, many of the automatic features available reduce the need for operator involvement. And because the Senturion 200 is totally modular, all systems are flexible and expandible - capable of meeting the changing needs of your operations.

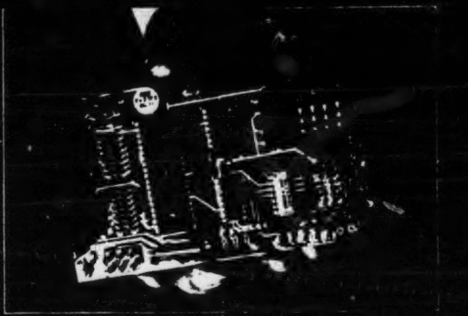
The Senturion 200 - inexpensive, reliable, safe and easy to install - a total Control, Monitoring and Management system. It is designed to increase production, lower costs and improve the safety conditions resulting in a more profitable operation.



MONITOR CONTROL ALARM

Accessor ® Trunk Cable

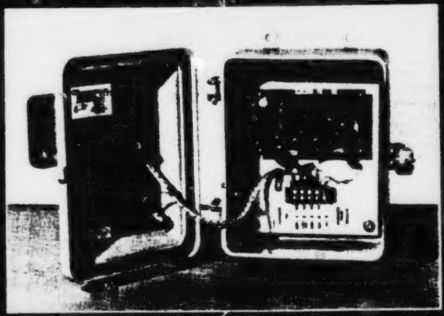
Varying in length to suit the distance required the compact four wire trunk cable measuring less than ½" in diameter provides both power and communication from the central command computer to 'accessors' and remote sensors placed throughout the area being monitored or controlled.

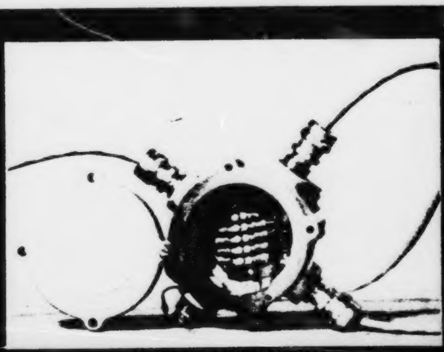


The Accessor ®

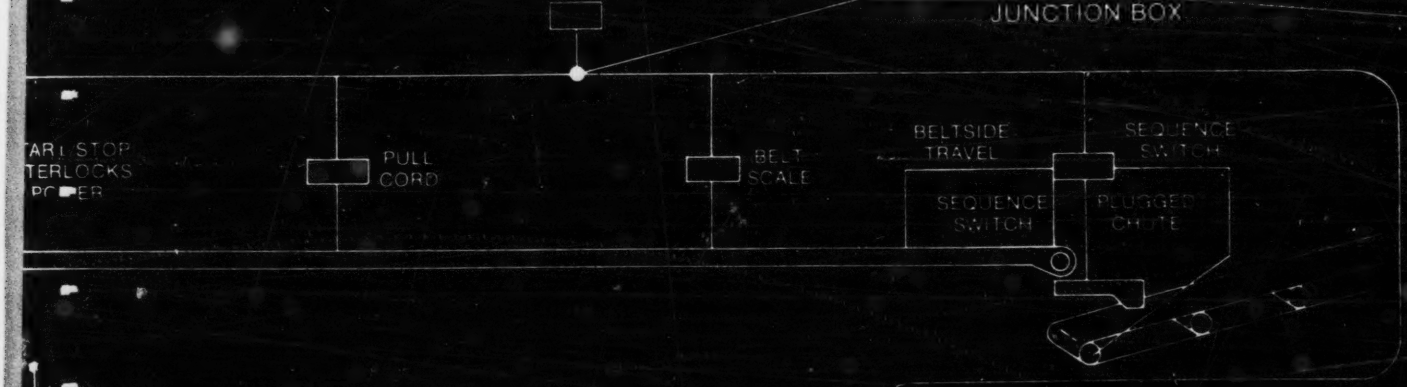
Unlike other systems which require a number of field cabinets and a bulky amount of cabling to transmit information, the Senturion 200 uses a small 'Accessor' placed beside each piece of equipment along the Accessor Trunk Cable. By installing the Accessor directly beside the equipment or operation being Controlled and Monitored, some basic and important advantages are presented:

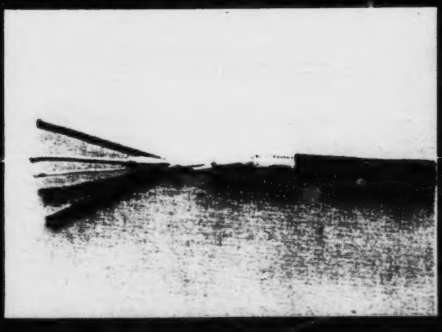
1) Substantial reduction of wiring and installation costs,
2) Standardization of hardware,
3) Ease of additional future points,
4) Need for local power source eliminated,
5) Allows stocking of standard replacement parts.

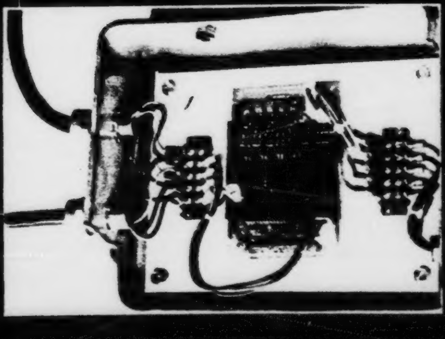




JUNCTION BOX


AIR FLOW
SENSOR
ART STOP
TERLOCKS
POWER
PULL
CORD
BELT
SCALE
BELTSIDE
TRAVEL
SEQUENCE
SWITCH
SEQUENCE
SWITCH
PLUGGED
CHUTE

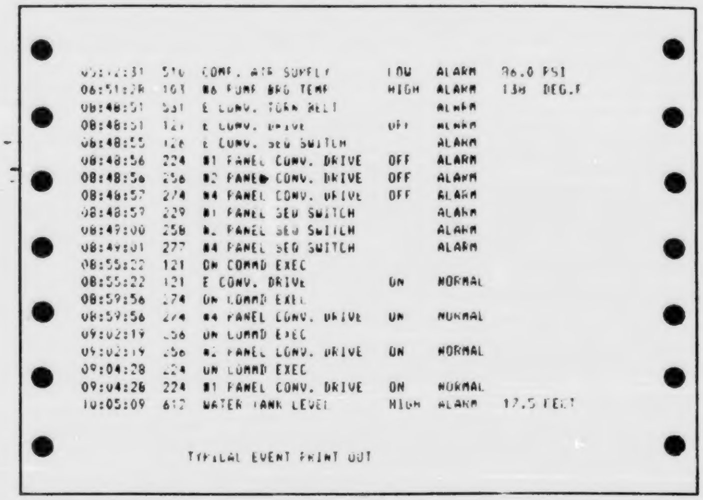




Operating Routines

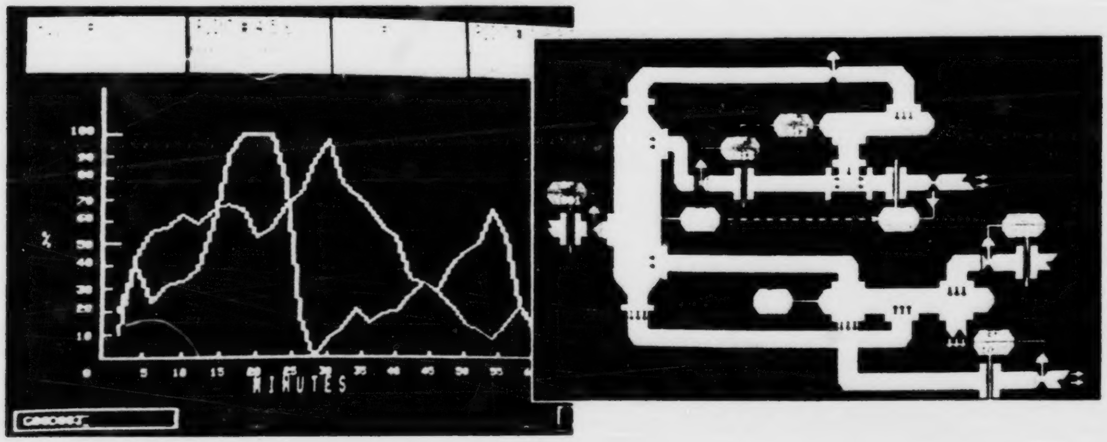
Operation of the Senturion 200 is simple and straight forward. The system allows the user at the command center to implement the automation, control and monitoring of equipment as needed. The following lists some of the operating routines carried out by the Senturion 200:

- English language keyboarding eliminates the need for computer-skilled personnel in the programming and operation of the system,
- Monitoring and Alarm identification provided for all operating equipment,
- Supplies immediate information on the equipment status, quickly pinpointing fault conditions,
- Provides automatic warning to remote work sites,
- Allows for centralized control of equipment and overriding of local controls,
- Provides automatic sequential start-up and shut down of equipment,
- Produces Status, Alarm, Shift and Production Reports as well as Trend Logs and Color Graphics action displays,
- Generates automatic preventative maintenance work orders for equipment,



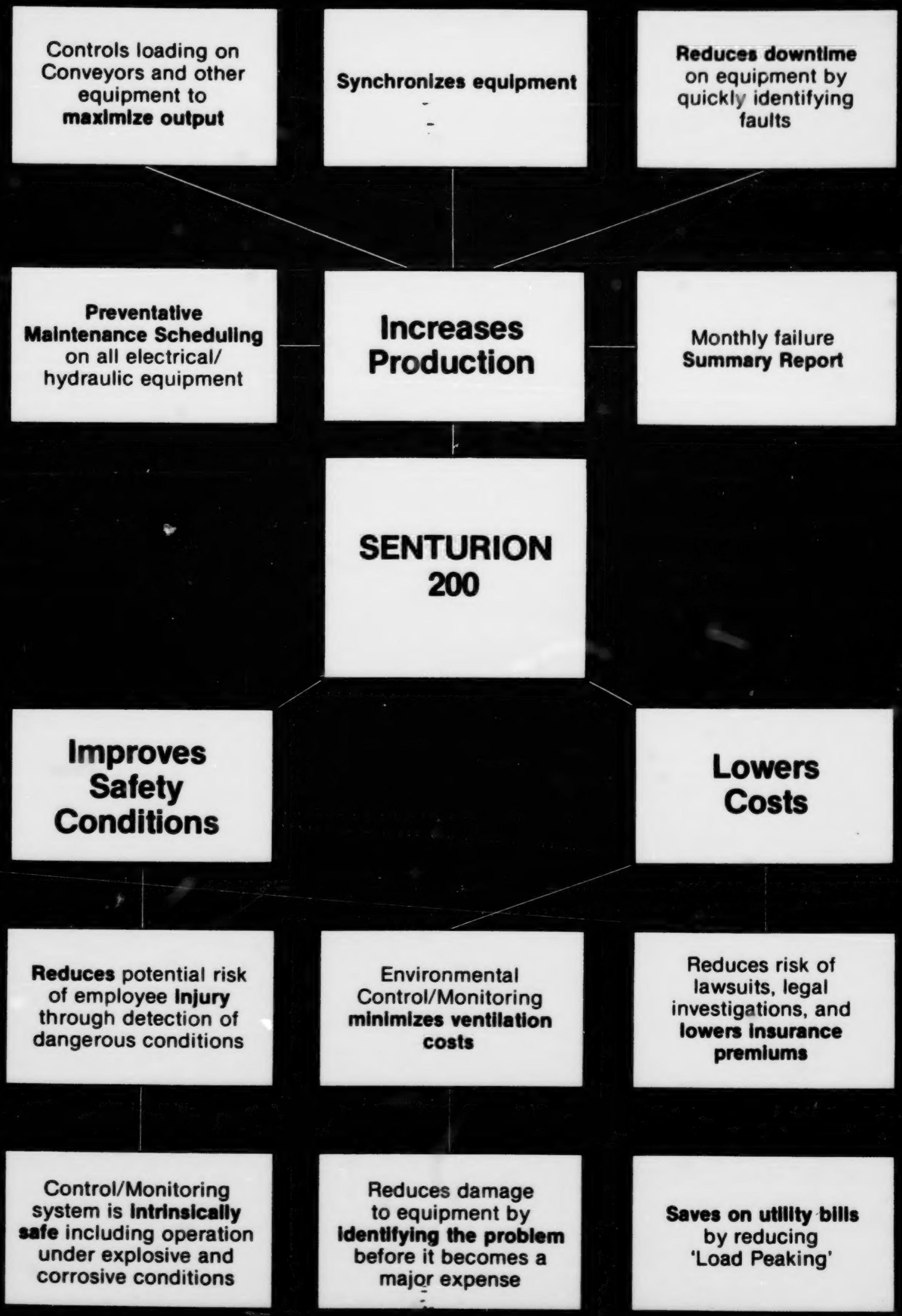
```
05:[illegible]:31  510  COMP. AIR SUPPLY        LOW   ALARM   86.0 PSI
06:51:28  163  #6 PUMP BRG TEMP        HIGH  ALARM   138  DEG.F
08:48:51  531  E CONV. TORN BELT             ALARM
08:48:51  121  E CONV. DRIVE           OFF   ALARM
08:48:55  126  E CONV. SEQ SWITCH            ALARM
08:48:56  224  #1 PANEL CONV. DRIVE    OFF   ALARM
08:48:56  256  #2 PANEL CONV. DRIVE    OFF   ALARM
08:48:57  274  #4 PANEL CONV. DRIVE    OFF   ALARM
08:48:59  229  #1 PANEL SEQ SWITCH           ALARM
08:49:00  258  #2 PANEL SEQ SWITCH           ALARM
08:49:01  277  #4 PANEL SEQ SWITCH           ALARM
08:55:22  121  ON COMMD EXEC
08:55:22  121  E CONV. DRIVE           ON    NORMAL
08:59:56  274  ON COMMD EXEC
08:59:56  274  #4 PANEL CONV. DRIVE    ON    NORMAL
09:02:19  256  ON COMMD EXEC
09:02:19  256  #2 PANEL CONV. DRIVE    ON    NORMAL
09:04:28  224  ON COMMD EXEC
09:04:28  224  #1 PANEL CONV. DRIVE    ON    NORMAL
10:05:09  612  WATER TANK LEVEL        HIGH  ALARM   17.5 FEET

             TYPICAL EVENT PRINT OUT
```

- Displays supervisory instructions, detailing how the operator should respond to alarm conditions,
- Delivers color plotting of Analog Values,
- Monthly Statistical Analysis Reports detailing important aspects of equipment failures,
- Offers computer modelling of the ventilation system with real time entry of ventilation variables,
- Future forecasting the possible progression of fires and other environmental developments.



Color Graphics Display

This simulated visual aid allows the operator to evaluate and analyse plant or mine operations with ease. Should the operator require a closer "view", the Color Graphics Display can enlarge a particular section providing close up shots. Up to 1000 graphics can be displayed and logged for future reference.



Controls loading on Conveyors and other equipment to **maximize output**

Synchronizes equipment

Reduces downtime on equipment by quickly identifying faults

Preventative Maintenance Scheduling on all electrical/hydraulic equipment

Increases Production

Monthly failure **Summary Report**

SENTURION 200

Improves Safety Conditions

Lowers Costs

Reduces potential risk of employee **Injury** through detection of dangerous conditions

Environmental Control/Monitoring **minimizes ventilation costs**

Reduces risk of lawsuits, legal investigations, and **lowers insurance premiums**

Control/Monitoring system is **intrinsically safe** including operation under explosive and corrosive conditions

Reduces damage to equipment by **identifying the problem** before it becomes a major expense

Saves on utility bills by reducing 'Load Peaking'

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[illegible] throughout Australia, Canada, [illegible] South Africa & U.S.A.

2. THE CONSPEC SENTURION 200 SYSTEM

The Conspec Senturion 200 mine wide monitoring system is designed to provide state-of-art computing and data logging facilities in order to assist mine management in the day to day running of their mine. The systems monitoring capabilities may be used to keep records, initiate command sequences, and finally to assist in troubleshooting system hardware.

2.1 Record Keeping

Record keeping is automatic for all changes of state or alarm occurrences. The operator is notified of these occurrences at the console so that remedial action may be taken if necessary. They also log the time out and into service of equipment. It can keep track of air door positions, operational status of fans and other motors. Continuous values of air velocity, methane, CO, or any environmental condition and can be set to warn of rapidly changing conditions before critical levels are reached.

Shift report printouts are used to calculate the average level in the monitored areas. Trend logs may be used to study instantaneous variations in connections with the mining activity, barometric changes, or fan shutdowns. These studies are used to improve ventilation effectiveness and thereby reduce ventilation costs.

2.2 Command Control

Command sequences can be constructed for either manual or automatic operation. This feature may be used to turn on, or off, a number of fans from the console in a predetermined sequence with time delays between steps. The status monitoring then gives feed-back to inform the operator of command execution and if indeed the fans went to the commanded state. Anemometers interfaced to analog accessors could be placed in the drifts as further verification that the fans were on or off. By using an accessor to monitor mine power, the above fan sequence may be set to automatically start up fans after a power outage. In this case, the power monitor would serve as the sequence trigger under return-to-normal conditions. Other sequence applications include activating warning horns prior to fan startup, turning on underground alarms or fans for high-environmental readings, or automatic startup of secondary pumps triggered by a water level monitor.

Troubleshooting system hardware (cables, accessors, and field devices) can be aided by using the system's monitoring capabilities. Certain types of alarms may be used to diagnose hardware problems and their locations. Basic hardware problems that will be detected by the computer include a break in the accessors cable, broken signal cable between accessor and field device, broken power cord to field device, and electronic malfunction in the field hardware.

Logs, reports and lists are available to the operator by typing a 3-letter mnemonic or dedicated function key. For all available commands see appendix D and for typical printouts see Appendix C.

2.3 Hardware

The Senturion 200 is a "Microcomputer-Based Real-Time Data Acquisition Monitoring and Control System". Its basic hardware consists of a central processor, data and event printers, communication trunks, and Accessors, (Single Point Transmitter Receivers). Two types of modems are included with the system for long distance operation.

2.3.1 Central Processor

The Central Station is a floor mount cabinet complete with a metal desk. It contains the main processor, disk drive, accessor trunk drivers, modems, power supplies, and uninterruptable power supply. The main processor is a Zilog-based microcomputer system which utilizes a Z80A central processing unit with both parallel and serial input/output (I/O) ports. Memory consists of 65,536 bytes of dynamic random access memory (RAM) with an addition 7,168 bytes of erasable programmable read only memory (EPROM). A floppy disk controller is used to interface the system disk. Other components include direct memory access (DMA) logic, an onboard programmable read only memory (PROM) programmer, and a four-channel counter-timer.

2.3.2 Disk

The system disk utilize 8-in single-sided floppy disks and provides 256000 bytes of additional memory. Disks are used as non-volatile storage for programs and data. The disk drives are only activated during system startup, re-start, or long term data storage.

2.3.3 Terminal

A Rockwell 6502 microprocessing unit is used to control the CRT and keyboard. The alphanumeric keyboard is laid out similar to an office typewriter with additional special function keys used to simplify operator commands when in the main program. The key functions are displayed on the bottom line of the CRT, 66 dedicated functions are available.

2.3.4 Data-Event Printers

A Teletype 43RO is used with the system for character-at-a-time receive-only operation. The system is programmed for automatically and manually requested printouts. Automatic printouts are obtained for all alarms and events with their corresponding time of occurrences. The printer can also be requested from the keyboard to print out point descriptions, shift reports, trend logs, and other system configuration parameters. Examples of these printouts are shown in appendix C. Two printers can be used to separate the events from the reports and logs.

2.3.5 Communication Trunk Driver

The communication trunk is a line driver through which the system communicates with the accessors. The trunk is connected to the central processor via an RS-232 interface and to the accessors via a single four-wire cable. The trunk uses two of these wires to provide 24-VDC power to the accessors and environmental instruments; the remaining two wires are used to transmit and receive digital signals. Trunk-to-accessor communication is carried on asynchronously at a 4,800 baud rate.

2.3.6 Modems

The system also has the capability to monitor and control points many miles away, such as those at another mine, through the use of modems. The modems, referred to as long distance accessors (LDAs), consist of a local and a remote unit. There are two types of LDAs. FSK or PSK transmission.

2.3.7 FSK Modems

The FSK transmission between the local unit and the remote LDA may take place on dual metallic-shielded twisted-pairs or a half-duplex leased 3002 voice-grade telephone lines.

The distance is limited to 2.7 km with 18 American wire gauge (AWG) dual-cable for point to point installations. It is unlimited however, with the use of leased conditioned telephone lines. Several remote LDA units can be used with a single LDA local unit.

In order to ensure data integrity over leased telephone lines, the local LDA reduces the regular accessor trunk transmission rate from 4,800 to 600 baud for transmission to the remote unit. It also generates two transmissions of identical data to the remote LDA. When the local unit receives messages from a remote LDA, the messages are compared and the transmission rate on the remote trunk is restored to 4,800 baud into the accessor trunk.

The remote LDA functions as an accessor trunk driver by providing +24 VDC and 4,800 baud rate data transmission to the connected accessor trunk. In addition, it receives data from the local unit at a 600 baud rate, compares words and then speeds up the transmission to 4800 baud. Data from the accessors are slowed down to 600 baud and duplicated for transmission to the local LDA. These units are primarily used when the communication cable is leased from a telephone company and the transmission may be through an exchange.

2.3.8 PSK Modems

The PSk transmission takes place on a single metalic shielded twisted pair of wires. These units operate at accessor trunk speed 4800 baud. Multiple remote LDAs can be used with one local LDA. The distance transmitted can be up to 5.5 miles of connected wire.

2.4 Accessors

Accessors provide the interface between the system and the field devices to be monitored or controlled. At the heart of each accessor is an addressable universal asynchronous receiver/transmitter (UART) chip. This chip has an asynchronous data format consisting of a serial stream of data bits. The UART receives two 8-bit words in a serial data stream from the processor; the first word received is an address and the next is a command. If the address sent matches the programmed address of the receiver, the transmitter is enabled to transmit two data words consisting of accessor identity and status.

Each accessor, then, is actually a point multiplexer with its own unique selectable address, variable from 0 to 127. Identities are also selectable and are used by the processor to handle the returned data.

Accessors are classified as either analog, binary, pulse input or analog and binary output. To customize each accessor, special sheets are provided (ref. page 4-9). These sheets are formatted to duplicate the computer requests for data. These prompts are requested in areas 2 of the CRT (ref. page 3-4).

2.4.1 Binary Accessors

Binary accessors control and/or report status from contacts.

Available accessors for monitoring binary statuses include the B1, B20, B21, B24 and B30.

Applications of these accessors include bulkhead door position monitoring, vent fan monitoring, mine power monitoring, conveyor limit switch and pull cord monitoring.

Avaliable accessors for providing binary controls include the B2, B3, B22, B25, complete with interface relay packs.

Application of these accessors include Start/Stop and monitor fans, pumps, conveyors bulkhead doors, power breakers, tap chargers, any 2 or 3 state control.

2.4.2 Analog Accessors

Analog Accessor control and or report continuous analog values detected by a sensor or process transducer. They convert analog signals from field devices to digital form. This value is then supplied to the processor upon interrogation. There are 20 different types of these accessors which are designed to accept most common analog input ranges (e.g. 4-20mA, 0-5V etc).

The signals from the appropriate sensors are converted into analog values by a selected process transducer. The accessor accepts the analog value which is digitized for transmission to the central processor. The process transducer may be located up to 160 m from the accessor without loss of accuracy.

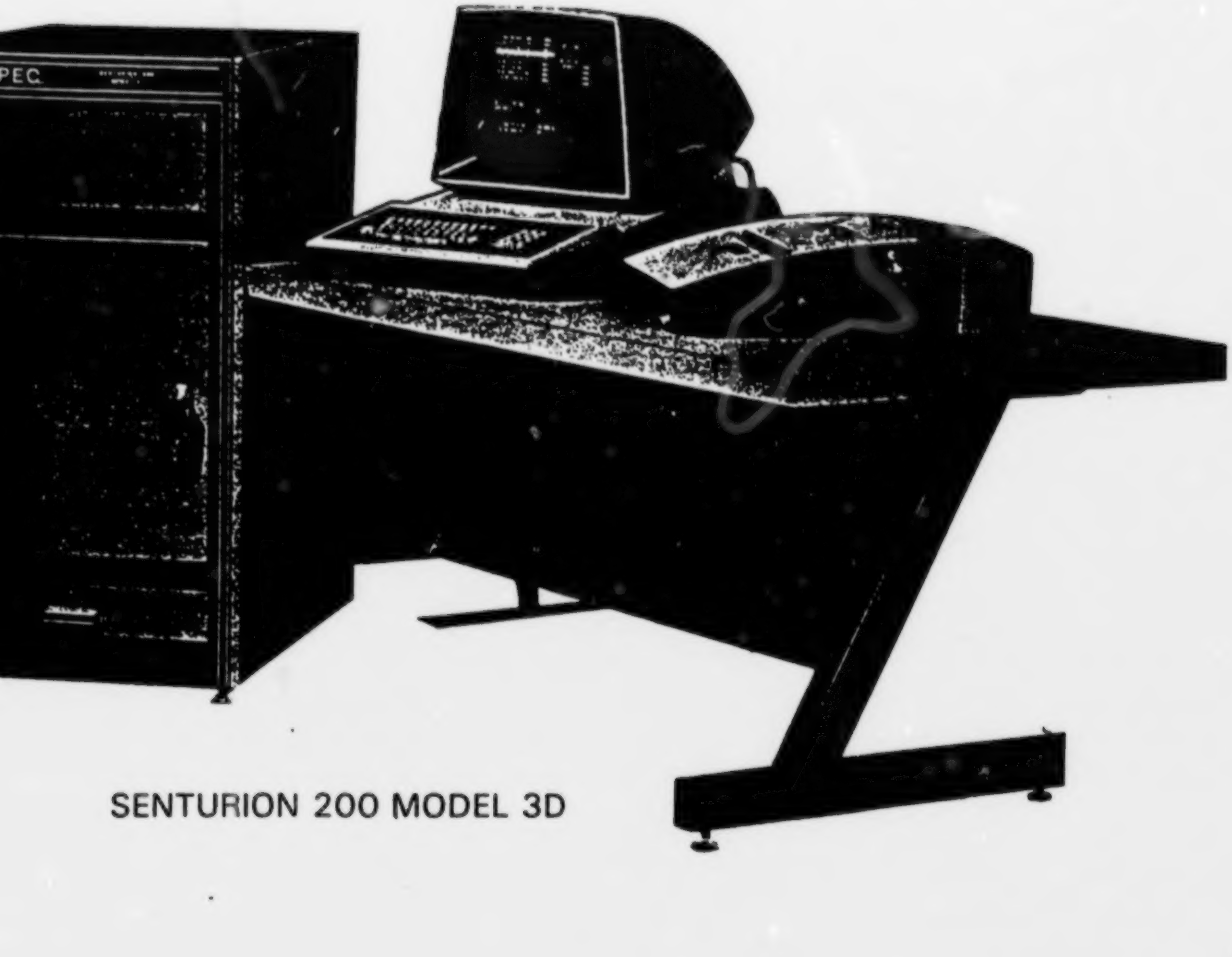
Typically, these Accessors are used with anemometers to report air velocity, temperature and relative humidity sensors, CO sensors, methane sensors, RTD, & thermistor probes and all process transducers.

Analog Output Accessors are classified as commandable analog accessor. The outputs are controlled and can be voltage, M. Amp, or six bit binary combination of enabled/disabled states. These accessors can be used to vary motor speeds, adjust louvre damper positions, valve positioners, etc.

2.4.3 Pulse Input Accessors

Pulse Input Accessors accumulate pulses generated by power demand meters, load cells, running time meters, working level (WL) environmental monitors etc,.

y major repairs and reducing downtime.



SENTURION 200 MODEL 3D

SENTURION 200

3. SENTURION 200 SOFTWARE

Senturion 200 software is made up of two parts: the operating system and application programs. The operating system uses CP/M* and it consists of programs that execute user commands and permit access to hardware resources such as the CRT and printer. The basic system executive and boot-strapping programs are stored in EPROM memory to enable the CPM to be transferred from disk to RAM on power-up. Applications programs accomplish data acquisition, monitoring, and control of the various points. Additionally, an off-line diagnostics software package is supplied with the system, that is resident in EPROM. (See Appendix A).

3.1 Application Software

Once the CP/M is booted, the user can enter into application programs written by Conspec. These various programs, perform in concert with each other and comprise the main program. A keyboard command (see section on system startup) initiates the loading sequence which first alters the RAM configuration to 65,536 and then loads hexadecimal files stored on disk.

After loading, the computer will display memory locations and other data. These locations correspond to slots in the startup procedure. When loading is complete, the loading sequence is terminated and the main program is started. The main program runs in a continuous loop to perform its monitoring and control functions. While in this mode, only application commands are permitted; that is, CP/M commands are invalid. To get back into the CP/M mode, a cold boot must be performed as explained in the startup procedure.

---

* CP/M is a trademark of Digital Research.

Application programs written by Conspec include the main scan program, command service, alarm printer service, CRT display service, and other regular and custom software.

3.2 Main Scan Program

Once in the main program, the processor continuously sends messages to the accessors in a predetermined sequence. Messages consists of an address and a command to which the appropriate accessor responds by returning its identity and status. Status consists of digitized information which may represent an analog reading or the position of contacts.

After requesting information from an accessor, the processor must wait several milliseconds for data to be returned. During this time it performs the remainder of its tasks such as updating the CRT or performing calculations. If no data are returned from an accessor, as would be the case with broken communication lines, the processor will make two more attempts to communicate. Then continue with the scan, starting with the next address. On the next scan the processor will try three times to communicate with any failed Accessor then if no data is returned a communication Fail alarm is generated. The scan only checks those accessors which the operator has enabled through the keyboard. Scan time per accessor in on the order of 10 msec; total scan time depends upon the number of enabled accessors on-line.

For binary points, received data are checked against the last valid reply received. If they match, the message is ignored and no updating occurs. With analog points, the received data are checked for normal or alarm condition and the delay to alarm counter (up to 255-sec delay permitted) is updated accordingly. If there is a change in the data received, the processor would determine the nature of the change and record this information in a temporary buffer. From there the information is decoded and displayed on the CRT and printed on the printer if desired.

3.3 Command Service

Command requests may originate from either the keyboard or from a programmed event sequence. It is possible for both to be in simultaneous operation on a time-share basis. Command requests are prioritized when issued, and a system executive processes them for priority before passing them to a command execution routine. This routine includes printer use and also determines the action required (such as to abort or continue the command) based on the result of execution attempts. If a command initially fails, it is tried again twice. The operator is then notified on the CRT as well as the printer of the command's result.

3.4 Alarm Printer Service

The user can select at the time of data entry the conditions under which a point's status will be printed out. If the print option has been chosen, then an event (change of state) would cause an internal buffer to be filled. This information would then be transferred to the printer. The following formatting is observed:

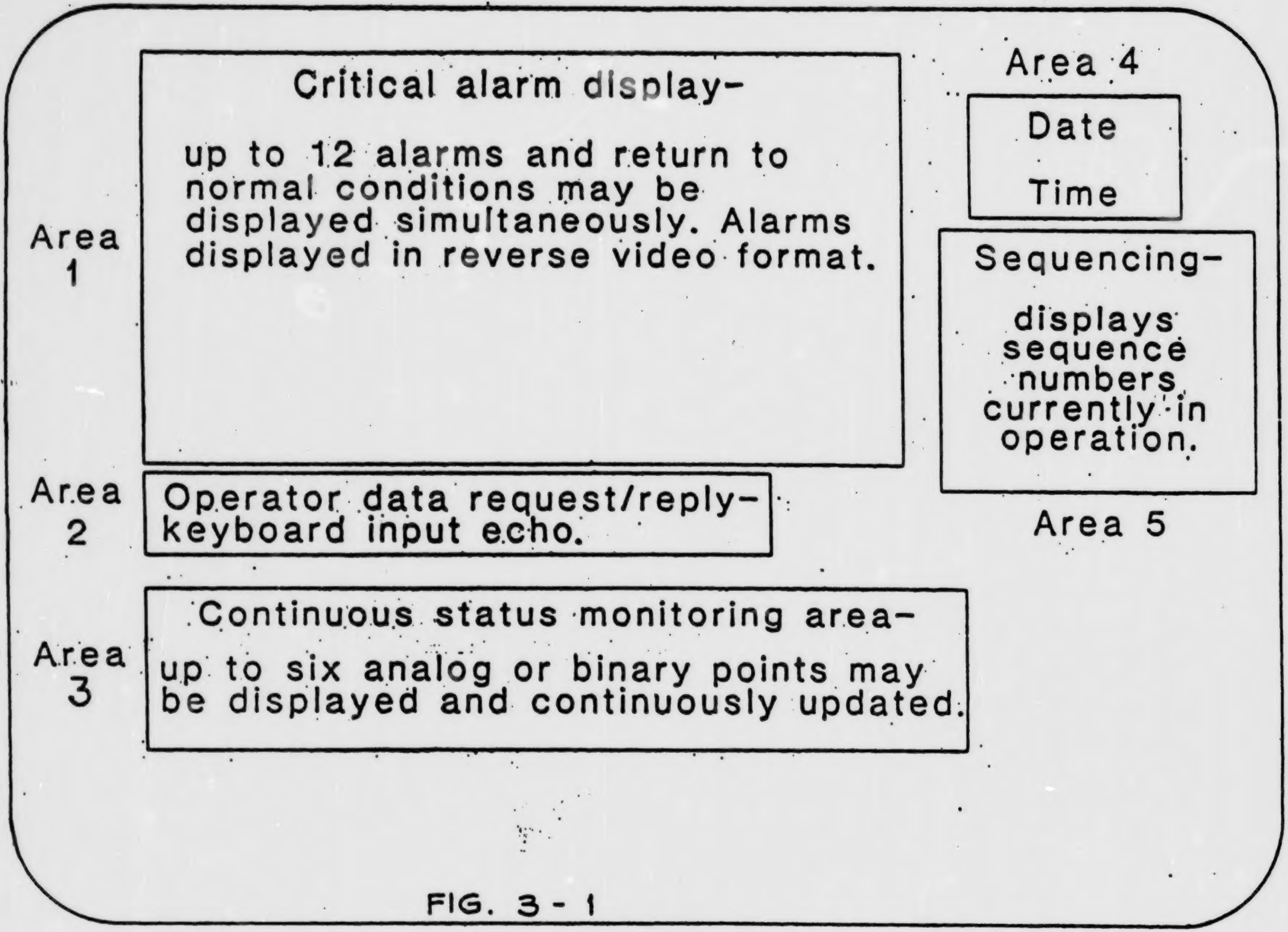
TIME PT. NO. DESCRIPTOR MODE 1 OR 2 MODE 3 OR 4 STATUS
VALUE

STATUS indicates the status of the point and will be one of the following:

NORMAL, ALARM, communications failure (C. FAIL), communications restored (C REST), sensor lines open (SLO), and sensor lines closed (SLC). For analog points, the ALARM status will have an identifier such as HIGH, LOW, or RATE. An example printout for both binary and analog points is shown in Appendix C.

3.5 CRT Display Service

The CRT screen is divided by software into five display areas as shown in figure 3-1. Area 1 contains 12 lines reserved for critical change-of-state conditions. As these conditions occur, the processor enters the data in this alarm zone and denotes new entries with a flashing chevron () to the right of the data. The user may acknowledge the event by pressing the special ACK key on the keyboard; the chevron will then disappear. If the event is an alarm condition, a horn will sound which can be silenced by pressing the SIL special key. Since this display area contains only 12 lines, provision has been made to store remaining alarms (up to 255) in a temporary buffer until CRT space becomes available or the auto roll mode may be selected. If all CRT space has been filled and there are waiting alarms, a cursor, which appears to the left of the displayed alarms, will blink. The user can edit the display by positioning the cursor to any point and deleting a line. New lines will automatically appear at the bottom of this display area. Software protection prevents line deletion if any unacknowledged events are present. Alarms are displayed in a reverse video format for easy identification.



Critical alarm display–

up to 12 alarms and return to normal conditions may be displayed simultaneously. Alarms displayed in reverse video format.

Operator data request/reply– keyboard input echo.

Continuous status monitoring area–

up to six analog or binary points may be displayed and continuously updated.

Sequencing–

displays sequence numbers currently in operation.

FIG. 3 - 1

Area 2 is reserved for communication with the computer. Keyboard inputs are echoed in this area. The computer also uses this area to prompt the user for data entry.

The program is set up in such a way that invalid data input will be ignored. All user commands in the main program mode, except for ones initiated with the special function keys, consist of three-character mnemonics.

Area 3 contains six lines reserved for monitoring the continuous status of random points. Any point chosen for display in this area will be continuously updated with current analog value of binary status.

Area 4 is serviced by a special program to display the current time and date.

Area 5 is reserved for event sequencing activity. Any sequence currently in operation will be displayed in this area; also, interrupted sequences sorted in order of priority will be noted.

3.6 Event Sequencing

The event sequencing software provides another dimension in the system's monitoring and control capabilities. With this software, the user is able to program event sequences with time delays of up to 255 sec. between events. These sequences may be started in two way; manually (ESQ command) or automatically. Automatic sequencing is possible by setting a trigger to initiate the sequence. The trigger can be set on any point in the system; when this point changes to the specified state, the sequence is started by the processor. Changes-of-state permitted for triggering include normal, alarm, high -alarm, low alarm, mode 1 (on) mode 2 (off) and communication failure. Event sequencing has been used to restart fans after power fail and to control LED indicators representing underground alarm conditions, and to sequence conveyors.

The sequencing software contains 255 sequence processing units (SPU). Each SPU consists of a header with a priority (1, 2, or 3), three events, and a link pointer. Up to eight SPUs can be in operation at any one time; when more than eight have been queued, the processor sorts and performs them according to their priority. SPU's can be chained to any length by using their link pointer to point to another SPU.

Events consist of three types: tests, commands, and null events. These are discussed in the following paragraphs.

Tests may be applied to any point in the system and may be used to direct the flow of the sequence. Test conditions include normal, alarm, communication failure, and less than, equal to, or greater than a test value. Conditional jumps or calls may be chosen as a response to the test result. A jump, when chosen, diverts the sequence to another SPU if the test condition is false. A call, (when the test condition is true), performs another sequence as a subroutine before continuing with the original sequence. The call depth is limited to four calls.

Commands in a sequence behave in the same manner as operator commands entered through the keyboard. Although any type of point may be tested, only commandable accessors such as the B2, B3, B22, C5 etc, types may be commanded. Time delays up to 255 sec. are permitted after a command event.

A null event is used to produce no action for a particular event during sequence processing. This event causes the processor to proceed to the next event in the sequence. Null events are desireable because of programming considerations.

The upper right of the CRT display, in an area immediately below the time, contains an area reserved for sequence display. In this area there are eight lines corresponding to the eight activity nodes for the sequences. As a sequence is queued, the first or header SPU number, the current SPU number in operation, and the event number within the current SPU are displayed on one of the lines. When all of the lines are filled with operating sequences, new incoming sequences will be held until an activity node becomes free. A priority 1 (highest) sequence will temporarily interrupt sequences of lessor priority for processing if all nodes are in use.

4. SYSTEM INSTALLATION & STARTUP PROCEDURE

4.1 Installation

Installation of the system is a mine typically consists of:-

(a) Running the trunk cable between accessors.

(b) Installation of remote trunk driver assemblies.

(c) Installation of surge protection.

(d) Installation of the surface processor hardware.

This is followed by a checkout of the cables, final hookup and accessor voltage checks.

Cable should be placed along the mine back or ribs in such a way as to avoid being snagged by mine equipment. Before installing this low voltage cable near metal pipe, regulations should be checked to ensure that this is in compliance with safety codes. It is preferrable not to run the cable next to power or feeder cables in order to avoid stray electrical interference. A minimum seperation of 4 to 6' is recommended. Supporting of the cable is determined by the application. Gauge of the power wires in the cable is determined by total length of run to minimize voltage loss due to impedance (accessors are designed to function with 13.7V minimum. (non-IS) or 8V (I.S.) The cable has two 12 AWG power wires and two 18 AWG data wires, one shielded, in an overall shield with a common drain. For extra heavy duty installation an additional outer shield and jacket are provided. This cable was found to be sufficient in runs up to 4000' from the trunk driver. Voltage boosters and wave shapers may be used to compensate for line loss in runs of greater length.

Accessors should be installed within proper distance limits to their field devices. Both accessors and field devices should be placed in protected areas to minimize unintentional damage from personnel or equipment. The accessors are housed in waterproof metal enclosures; wires are brought inside through strain relief-type connectors. After connection to the field devices and prior to connection to the accessor trunk cable, an accessor checker should be connected to the accessor cable plug on the accessor. By setting the switches on the checker to match the accessor code it is possible to simulate the signals sent by the computer. The accessor should respond with correct data based on the activity of the field hardware. If correct, the accessor trunk stub cable can be inserted on the accessor plug. Check the voltage and if within specification, the accessor is ready to be added to the system scan.

A surge protection unit is installed at the mine portal to protect underground equipment from volage spikes induced by lightning. The communication trunk driver is already internally protected from lightning-induced voltage spikes.

Basic equipment at the surface consists of central processor, printers, battery backup unit, and communication trunk, driver or modem. A line filtering conditioner is recommended to reduce voltage spikes coming in on the 110VAC line. All equipment should be set up and checked out prior to connecting the driver to the accessor cable.

After installation each accessor that has been checked out with the accessor checker can be checked using the accessor checker diagnostic software. This is used to determine proper operation of each accessor, when commanded by the computer.

4.2 Startup Procedure

The following step-by-step procedure assumes all surface and underground connections have been properly made.

1. Ensure that power is on the terminal and printers.

2. Turn on disk drive, insert the system disk into the drive, and close the door.

3. Cold boot the system into the CPM Mode by performing the following steps:

   a. Push the reset button on power panel.

   b. Type the keyboard space bar to obtain the CRT message:

   ```
   MPS-93
   ```

   c. Type "F" on the keyboard.

   CPM will now be loaded into RAM from the disk. After loading is finished, the following will be displayed on the CRT:

   ```
   FQCPM V1.1

   A
   ```

The A is known as the A prompt, where the letter A corresponds to the disk drive designation. The computer is now waiting for further user input. At this point, the user enters the main program mode. A restart (warm boot) of the system at this point can be accomplished by typing control C.

4. To enter into the main program mode, type:

```
SUBMIT S (return)
```

This will cause the main program to be loaded into RAM. The disk drive red light will click on and off for approximately 1 min. as this is accomplished. During this time the CRT will display the files that are being loaded. In addition a check of the RAM memory is performed. This is displaed as follows on the CRT:

```
TEST 1
TEST 2
TEST 3
TEST 4
```

5. After the main program is loaded, an initialized date and time will appear on the CRT along with the message:

```
              READ STATUS FRM DISK

      OPTION (Y or N)               X (flashing)
```

If this is the first time the unit has been turned on since it was installed, no status information would be on the disk. In this case, the user would respond "N" (no) to the prompt and type the return key. The user is then required to enter the system status into memory via the keyboard (see section on Data Entry).

If status has previously been saved, the user would type "Y" and the return key. This causes all system status on disk to be loaded into memory, a process which takes approximately 1 min.

From this point onward, user commands consisting of 3-character mnemonics or function keys may be typed on the keyboard. The computer responds to these commands with specific data entry prompts.

6. When the system is finished with the loading process, turn off the disk drive. The user must now enter an access code in order to communicate further with the computer. Two access codes are available corresponding to a lower (operator) and a higher (supervisor) level of access.

The lower level code allows the operator to perform basic house-keeping functions oriented to system maintenance. These include manipulation of CRT display, editing the scan, commanding control points, temporarily changing analog parameters, and requesting certain print routines.

The higher level code allows the supervisor to enter new points or delete old ones, control disk I/O, set up shift reports, program event sequences, and generate certain print routines. This level of access also includes all commands in the lower access level. An ACCESS ALLOWED message on the CRT notifies the user that the code was valid and that further input will be accepted.

7. Set the time by typing STT. The computer will respond:

```
STT             SET TIME
ENTER TIME    HH:MM:SS
```

Enter the present time in 24-hr format.

8. Set the date by typing STD. The computer will respond:

```
STD           SET DATE
ENTER DATE    MM:DD:YY
```

Type in the number corresponding the month, day and year. After the user returns this information, the date will be updated and the new date and time will be printed on the printer.

9. Data Entry:

The data base, or status, consists of all the parameters that are user keyed which may be saved on and read from disk. This includes point numbers, addresses, trunk number, etc., as well as sequencing programs and programmed shift report or trend log routines. Initially, the user will have to enter status through the keyboard by using special data entry commands such as NEW. The user is aided in data entry by computer prompts.

The NEW command is used to enter specific accessor information such as point number, accessor type, address, trunk number, annunciation options, and other parameters. Data entry sheets which follow the flow of the prompt sequence should be filled out before hand. See data entry sheet in figure 4.1.

For analog points, the computer will also prompt for parameters such as correction factor and offset reference numbers, (see Appendix B), alarm limits, units code, and delay to alarm. These parameters may be changed any time after initial entry through the CAP command. The prompts for this command display previously entered values and will accept new input. Values that the user does not want to change may be skipped by typing the special SKIP key.

Correction factors and offset values are actually entered into a reference table within memory. The reference number for a particular correction factor (CF) or offset (OFS) is used in data entry for analog accessors instead of entering the actual value. More than one accessor may refer to the same CF or OFS in the table. Up to 255 different CFs and OFSs may be stored in the table.

The CFI and OFS commands are used to enter correction factors and offset values into the table. A data entry format must be observed. The format for correction factor is: M*X.XX E SX,

where M = multiplier (1, 2, or 4).

X.XX = 3 digit value (0.00 to 2.55)

E = exponent base 10 (implied),

and SX = sign and exponent (-7 to +7).

The format for offset is:

S*.XXX E SX,

where S = sign of offset

X.XXXX = offset value (0.0000 to 7 9999).

E = 10 (implied),

and SX = sign and exponent (-7 to +7).

After data entry is complete the DSS, PAP and PCO commands may be used to verify proper entries. Each accessor must be enabled with the EDS (Edit Scan) command before it can communicate with the processor. The EDS command can also be used to disable points for maintenance or other purposes.

10. Operation:

While in the main program mode, the user communicates with the system by typing commands on the keyboard. The two access codes presented in the startup procedure allow different levels of entry; supervisor commands are invalid to an operator-level entry.

Table 4.1 shows the standard command list for the Senturion 200. Note that additional commands are available depending on the software options selected. Refer to Appendix D for a more detail.

ANALOG — DATA ENTRY NON COMMANDABLE AS

POINT NO. ☐☐☐ ....

ACCESSOR DATA

Accessor Type 0

Accessor Address ☐☐☐ Trunk # ☐

ANNUNCIATION DATA

(Complete Y = Yes or N = No)

Report Type ☐

Print ☐ Display on CRT ☐ Horn on Alarm ☐

SCALING AND ALARM DATA

Offset .... Offset Reference No. ☐☐☐

Correction Factor .... Corr. Factor Ref. No. ☐☐☐

Low Alarm Limit .... ☐☐☐

High Alarm Limit .... ☐☐☐

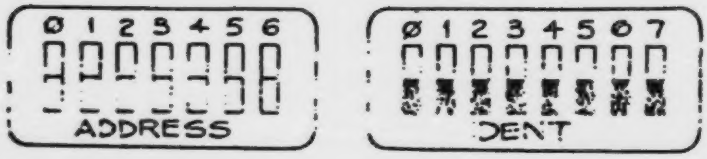
Units Code ☐☐ ....

Delay to Alarm ☐☐☐ seconds.

DESCRIPTOR

☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

ACCESSOR DIP SWITCH SETTINGS



ACCESSOR JUMPERS	
IN	OUT

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fig 4.1
Typical Data Entry Sheet.

Table 4.1

SENTURION 200 OPERATOR CODE COMMANDS FOR STANDARD SYSTEM

A Operator Code Commands

1. STT - Set the Time
2. STD - Set the Date
3. CS1 - CS6 - Continous Status Line 1-6
4. COC - Control Command-Binary
5. EDS - Edit Scan
6. ROL - Auto-Roll Acknowledge
7. ISR - Immediate Status Request
8. CAP - Change Analog Parameters
9. LTT - Enter Trend Log Data
10. ACC - Print Accessor Scan List (Sorted by Address + Trunk No.)
11. DSS - Print Descriptor List (Sorted by Point No)
12. CRT - Clear CRT-Screen
13. RPA - Reset Pulse Accumulator (D1)
14. REQ - Request Shift Report Current (does not reset the count or average)
15. CPA - Control Point Adjust
16. TTT - Termination Code
17. RCP - Reset Command Priority
18. PAP - Print Analog Parameter
19. ALS - Print Alarm Summary
20. ALP - All Points Log
21. FLP - Free Log Printer
22. PSS - Printer Selection

table 4.1 Continued

Operator Commands for Sequence Programming
See Programmable Event Sequence Manual

23. ABT - Abort a Sequence

24. ESQ - Enter a Sequence in the Queue

25. HLD - Put a sequence on hold

26. RLS - Release a Sequence from hold.

Table 4.1 Continued

B. Supervisor Code Commands

1.	NEW	- New Accessor Data Entry
2.	TSR	- Shift Report Time Entry
3.	SPN	- Shift Report Point Assignment
4.	DSE	- Descriptor Entry Change
5.	EAC	- Enter/Change Access Code
6.	KIL	- Kill or Delete a specific point data
7.	SVD	- Save on Disk
8.	RDS	- Read Data from Disk
9.	FMT	- Format a Disk
10.	CFI	- Enter Correction Factor into Reference Table
11.	OFS	- Enter Offset data into Reference Table
12.	PCO	- Print Correction Factor and Offset Table
13.	DMP	- Dump Memory
14.	IDN	- ID Code Selection

Supervisor Commands for Sequence Programming
See Programmable Event Sequence Manual

15.	XMS	- Examine or Alter an SPU
16.	CSP	- Clear or Re-initialize an SPU
17.	TRG	- Enter Sequence Trigger data
18.	PSQ	- Print SPU contents
19.	STP	- Print Sequence Trigger Data

5. SYSTEM INTRINSIC SAFETY EVALUATION

In order to obtain certification for the Senturion 200 system for use in underground coal mines it was necessary to perform the followng functions:-

(a) Identify all the components of the system that were required to operate in a hazardous (explosive) environment.

(b) Identify all the critical interfaces in the system, where the signals or power is connected across into the hazardous area.

Having identified all the critical components and interfaces it was necessary to next perform an evaluation of each of these components.

The primary method for evaluation used was the following:

(1) Is the component intrinsically safe already?

(2) If not, then is it possible to make the component intrinsically safe by minor design changes?

(3) If a complete new design is required then, determine firstly if the device is essential to system operation, and if so what is required to achieve this new design.

5.1 Identification of Components That Require Certification

An analysis of the Senturion 200 system shows that the following components are likely to be used in a hazardous environment.

1. Communication Cable from processor.

2. Modem and associated logic.

3. Trunk Driver Circuits.

4. Accessors.

5. Accessor Trunk Cable.

6. Power Source for the accessors.

7. Instruments and/or transducers.

5.2 System Components Evaluation

Each of the above components were then evaluated for intrinsic safety. A summary of these findings are indicated below:-

5.2.1 Communication Cable From Surface

The requirements here are twofold, i.e.

(a) The cable must be flameproof.
(b) The signals being carried must be I.S.

In view of the fact that the modems at the surface were not treated as I.S. devices this interface between the modem and the communication cable becomes a critical one. For this reason a barrier device, which limits the potential fault voltages and currents on the cable to a safe level was required. This was then designed by Conspec.

5.2.2 Modems and Associated Logic

These devices as used on the standard system were found to non-intrinsically safe, primarily because of the large capacitors used in their design. It was determined that there was no critical need for this device to be I.S. since both its communication the line input and RS-232 output could be made I.S. by the addition of suitable barriers. The input communication barrier would be the same as the one used on the surface modem. The RS-232 output would be barriered from the hazardous area by the trunk driver card.

5.2.3 Trunk Driver Circuits

The then existing trunk driver circuits were evaluated and found to be non-I.S. The reasons for this were the following:-

(a) The circuit used inductive line elements as protective devices (as an option).

(b) One large filter capacitor was employed.

(c) While the design provided isolation between the input RS-232 and the trunk outputs, the printed circuit layout did not provide sufficient clearances to ensure this isolation.

In this case a minor redesign was necessary to make the card intrinsically-safe. The following was done:-

(a) All inductive protective device option reference were removed from the drawings, and the printed circuit board.

(b) The value of the large capacitor was reduced to approximately one half its previous value, and a protective series resistor was wired in series with it to limit its discharge in the event of failure.

(c) A new artwork for the printed circuit board was generated.

5.2.4 Accessors

Each of the Conspec accessors was evaluated and found to be intrinsically safe if used by itself (i.e. not interfaced to any field device). It was necessary only to update the drawings and application data to specify the restrictions on the field devices (i.e. contacts, transducers, etc) that may be connected to the accessors.

Only those accessors that currently have high voltages applied to them were not found to be I.S. (B20 and control outputs types with 110VAC transformers on board). These devices were not submitted for approval.

5.2.5 Accessor Trunk Cable

The accessor trunk cable has two basic criteria to meet, i.e

(a) The cable must be flameproof.

(b) The signals being carried must be intrinsically safe.

Conspec cable meets the first requirement, whilst the second requires that all the signals (including power source) be intrinsically safe.

The remaining system problem therefore was to obtain a suitable I.S. power source.

5.2.6 Power Supplies

From the investigation it was evident that a suitable I.S. power source was required to power the accessors and transducers. An investigation of existing I.S. power sources showed that there were no suitable units for this system. Most of these power supplies have extremely low current output capacities since they are designed to power single instruments or devices. Where large output currents were available the output voltages were found to be extremely low.

Our power requirements were 20-30 volts DC at approximately 1 Amp. Analysis of the permissable output power curves (in a methane environment) showed that such a supply was possible (using a safety factor of 2), but that commercially available supplies, which were resistive by design limited the available current to 100 mA.

Conspec elected to use the P/S developed by the United States Bureau of Mines (USBM), Pittsburgh. This supply was reported to provide 20V and 800 mA. The USBM achieved this large output current by employing a different design technique. Instead of resistors to limit the output current, they used triple redundant high-speed current switches. Because of the need to detect faults at high speed, it was necessary that the switches respond to both the absolute level of current and also the rate of change of current.

Testing of the USBM P/S was satisfactory for purely resistive loads. All ignition tests passed. However, performance was unacceptable when connected to actual instruments and data communication hardware. There were two reasons for the poor results.

Firstly, all the instruments contained clocks and negative voltage generators which produced small ripple components in the current consumption at a frequency equal to the clock. Even though all the instruments tested drew less than 20mA ripple current, the P/S would shut down due to the high rate of change of current. The second problem was that the initial high current surge on power-up also caused the P/S to shut down.

Conspec made several modifications to its field hardware in an attempt to resolve these problems. The accessors were provided with a power switch and ramp circuit so that power to each instrument could be turned on sequentially and slowly to prevent power-on current surges. A filter was added to the Trunk Driver to reduce ripple current. On the instruments themselves, all negative voltage generators were removed and input filters were added. Despite all these changes, the USBM P/S still shut down about ten times per day.

Another problem area for the USBM P/S was in the design of the DC power supply to supply power to the I/S P/S. Conspec undertook this investigation and prototyped one unit. There was a very high input voltage requirement (48V) to contend with plus packaging problems from the point of view of electrical safety, heat dissipation, size, weight, impact resistance and battery gassing.

At this point, Conspec decided to review the situation, and the decision was made to develop our own power supply. The Conspec I/S power supply (P1166) was then designed.

The P1166 comprises of a triple redundant voltage regulator combined with resistive elements to reduce the output current. A detailed description and output characteristics curve are included in Appendix F. The P/S provides 15VDC nominal dropping to about 13.5 VDC at 500 mA load.

Prototyping and load testing were carried out at Conspec. The P/S was found to be satisfactory for our use.

At this point it was necessary to review the system once again in view of the reduced trunk voltage from the previous nominal starting voltage (24 volts).

Since only 15 volts was available, the voltage regulator devices used on the accessors was modified to allow the accessors to work off an 8 volt supply (where 8 volts was assumed to be the worst case end voltage on the trunk).

In addition an instrument power switch was added to the analog input accessors to allow for instrument power control.

None of the other system components were affected.

5.2.7 Instruments and Transducers

The system at this point dictated the instrument types that could be used. Primarily the considerations for suitability with the Conspec system are:-

1. Instrument voltage requirement should be as low as possible (i.e. ideally 5-10V range).

2. Current consumption of the instrument should be low, since a maximum of only 500 mA is available for all the instruments combined.

3. Instrument has to be intrinsically safe.

A number of instruments evaluated meets with these requirements.

1. The Air Flow Monitor, P1214, incorporating a J-Tec VA216B instrument.

2. Methane Monitor, P1216, incorporating a J-Tec VM101B instrument.

3. Carbon Monoxide Monitor, P1212, incorporating an Energetic Sciences (Ecolyzer 5001) instrument.

6. FINAL SYSTEM SUBMITTED TO CANMET FOR APPROVAL

6.1 Introduction

Central to the intrinsic safety of the system is the 15 volt, 500 milliampere D.C. power supply which is used to power the accessors and instruments in the hazardous area. This power supply together with the associated accessor trunk driver equipment, several accessors, cable and specific instruments were submitted to the Canada Centre for Mineral and Energy Technology (CANMET) for certification in 1982. Certification was given on December 16th, 1982.

Note:

Appendix E - contains a list of the actual drawings and transmittals made to CANMET for the intrinsic safety approval.

Appendix F - contains a description of the IS power supply P1166.

Appendix G - contains a copy of the review and testing correspondence between Conspec and CANMET.

Appendix H - contains a copy of the CANMET certification for the final system.

6.2 The Conspec I.S. Power Supply P1166

The power supply was designed and tested at Conspec. After extensive load testing to ensure suitability with the Senturion 200 system, the power supply was then submitted to CANMET for ignition testing. CANMET issued a report on May 26, 1982 which indicated that the prototype unit met the requirements for certification.

6.3 Remote I.S. Trunk Driver Unit

The basic underground communication station at which the link is made between the processor at the surface (via communication line or wire-pair) and the accessors (via accessor trunk) is called the Remote I/S trunk driver unit.

The Conspec P1188 Remote I/S Trunk Driver unit provides an intrinsically safe source of DC power and a communication channel to instrumnts located in hazardous areas of the coal mine. Central to the P1188 is the I/S Power Supply, P1166, described above. In addition to P1166 the following components comprise the Remote T/D unit;

Telephone Line Barrier Assy	P1193
Modem Assy	P1179
Modem Interface Assy	P1076
Trunk Driver Assy	P1163
DC Power Supply Assy	P1168
Battery	P1226
Explosion Proof Bo	P1178
Battery Box Assy	P1186
Hammond Transformer	P1187

The P1188 is fully described in the Conspec Engineering Manual, R1047.

The Remote I/S Trunk Driver Unit was reviewed by CANMET in a letter to Conspec dated September 17th, 1982. A clarifying response was returned to CANMET on October 5, 1982 (See Appendix C).

6.4 Accessors

Conspec submitted several of its accessors for certification by CANMET. Accessors are small printed circuit boards which communicate with the central computer from remote locations and perform the function of equipment monitoring and control. Because of the reduced output voltage from the I/S P/S, a redesign of the accessors was necessitated to reduce their minimum operating voltage from 13.8V to 8.0V. The following accessors were submitted:

B1, B2, B21, B24, B25
D1
A49-A61, A63, A64, A67

These accessors have been certified as intrinsically-safe with the stipulation that devices connected to the accessors must be approved for connection to I/S systems. Refer to Appendix G for CANMET reviews and Conspec clarifications, and to Appendix H for the certification schedule.

6.5 Accessor Trunk Cable

Trunk cable, P1209, was submitted to CANMET for vertical flame testing on December 6, 1982. Tests passed successfully and the cable was certified as part of the system on January 10, 1983.

6.6 Instruments

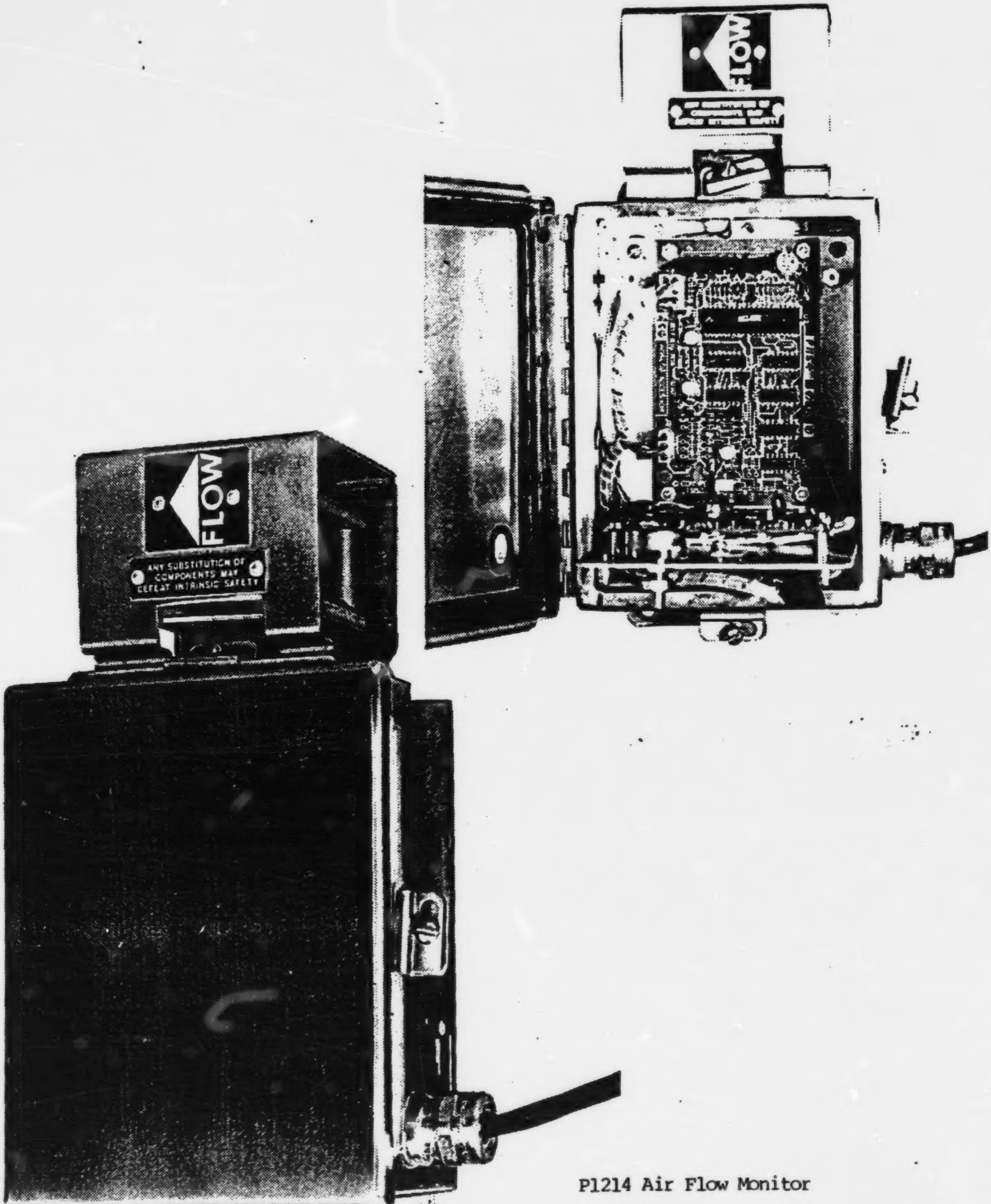
Three instruments for monitoring gas concentration were submitted for certification along with the Senturion 200. Changes that had been made to instruments at the time of the USBM changes in the nature of reducing input voltage and current requirements fitted in well with our lower operating parameters and made it possible for us to use the same instruments with no further modifications. These instruments are:

(a) Air Flow Monitor, P1214 incorporating a J-Tec VA16B instrument and a Conspec A50 Accessor. See Conspec Manual R1048.

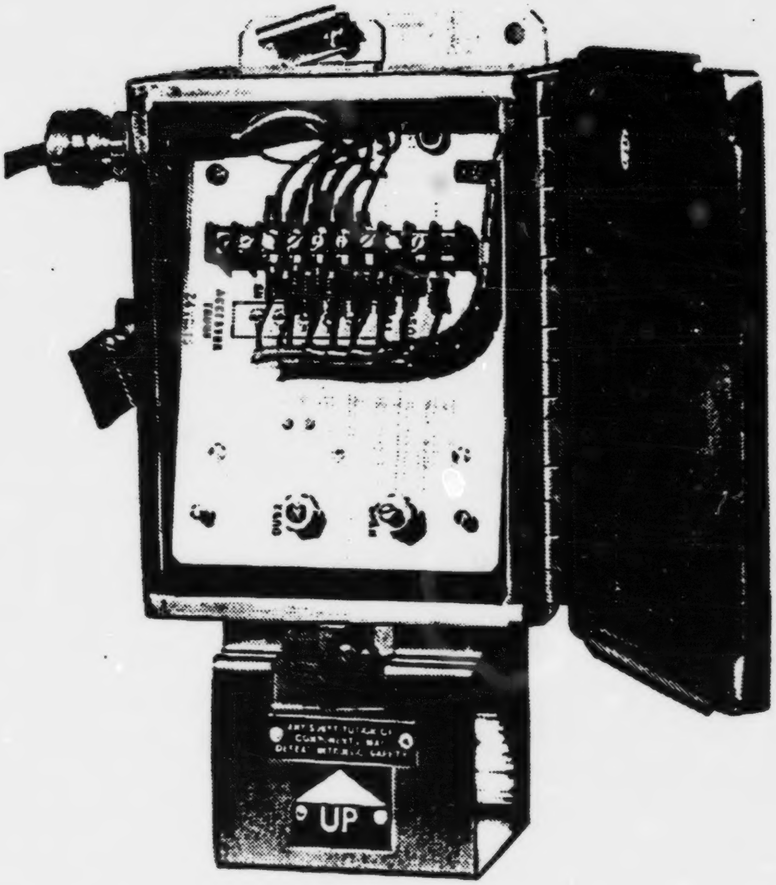
(b) Methane Monitor, P1216, incorporating a J-Tec VM101B instrument and a Conspec A61 Accessor. See Conspec Manual R1049.

(c) Carbon Monoxide Monitor, P1212, incorporating an Energetics Science (Ecolyzer) 500-DGFR instrument and a Conspec A60 Accessor. See Conspec Manual R1050.

The Air Flow Monitor, P1214, and the Carbon Monoxide Monitor, P1212, have been certified as part of the overall system. However, the Methane Monitor has been certified for electrical safety only, on a "per serial number" basis, for use in Government Mining Research organizations. Refer to Appendix D for details of instrument certifications as explained in G. Lobay's letter of January 20th, 1983.

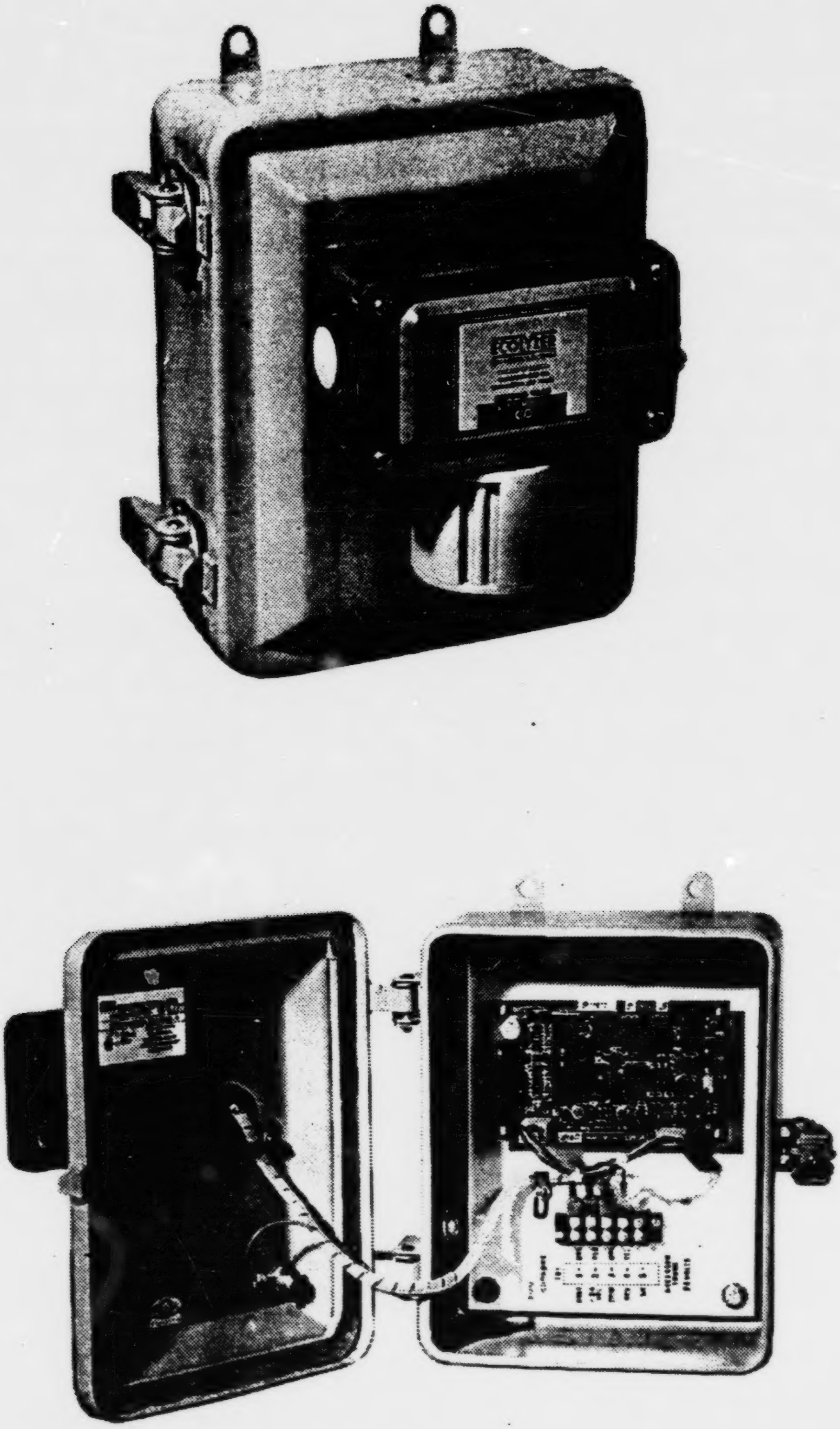

FLOW
ANY SUBSTITUTION OF COMPONENTS MAY DEFEAT INTRINSIC SAFETY
FLOW

P1214 Air Flow Monitor



P1216 Methane Monitor

P1216 Methane Monitor



P1212 CO Monitor

As of July, 1983 two additional instruments were approved for use on the system, these are:

(a) Sieger BM1 methane monitor
and (b) Mine Safety Appliances (MSA) carbon monoxide monitor.

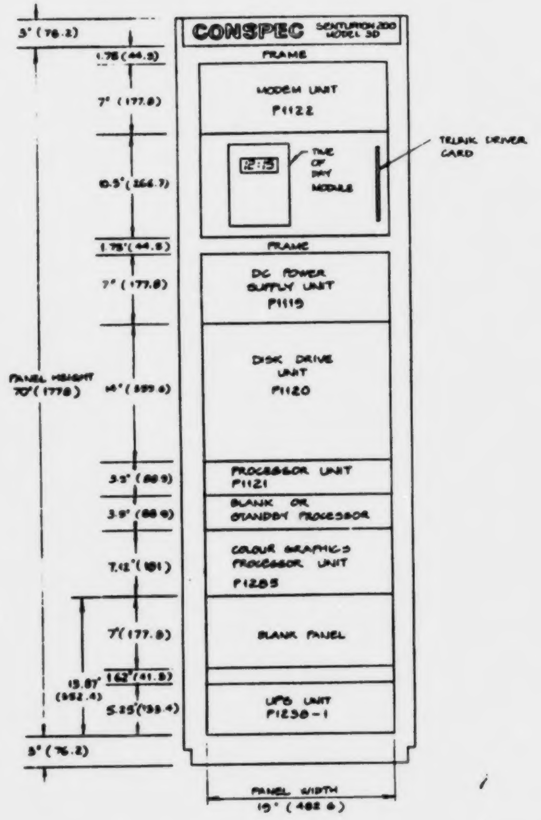
Reference EMR Certificate No. 474, Issue No. 4 (See Page H-13 of this manual).

6.7 Communication Line Barrier

The original approval of the system from EMR (see page H-7) did not extend to the communication link, between the surface and underground, since the terminology "telephone lines" was used interchangeably with "communication lines". As a result Conspec resubmitted for examination this part of the system, and it was determined that a redesign of the barrier was required. The barrier design was then modified and resubmitted for approval. The communication circuit barrier was approved (see page H-13 i.e. Certificate 474, Issue 4 item 3). This barrier now makes the link between the host at the surface and the underground trunk driver intrinsically safe.

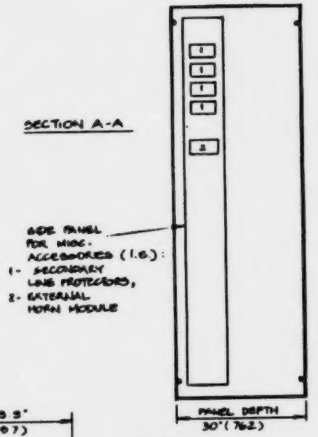
APPENDIX A

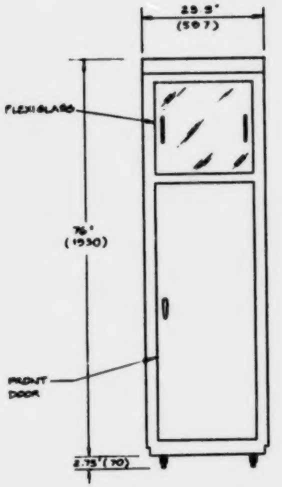
SYSTEM DRAWINGS


3" (76.2)
CONSPEC SENTURION 200 MODEL 5D
FRAME
1.75 (44.5)
7" (177.8)
MODEM UNIT
P1122
10.5" (266.7)
TIME OF DAY MODULE
12:15
TRUNK DRIVER CARD
1.75" (44.5)
FRAME
7" (177.8)
DC POWER SUPPLY UNIT
P1119
PANEL HEIGHT
70" (1778)
14" (355.6)
DISK DRIVE UNIT
P1120
3.5" (88.9)
PROCESSOR UNIT
P1121
3.5" (88.9)
BLANK OR STANDBY PROCESSOR
7.12" (181)
COLOUR GRAPHICS PROCESSOR UNIT
P1285
7" (177.8)
BLANK PANEL
13.87" (352.4)
1.62" (41.3)
5.25" (133.4)
UPS UNIT
P1230-1
3" (76.2)
PANEL WIDTH
19" (482.6)

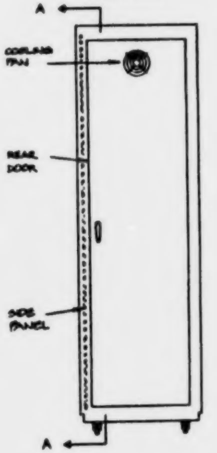
FRONT VIEW
(DOORS NOT SHOWN)

SECTION A-A


SIDE PANEL FOR MISC. ACCESSORIES (I.E.):
1- SECONDARY LINE PROTECTORS,
2- EXTERNAL HORN MODULE
1
2
PANEL DEPTH
30" (762)


29.9"
(507)
FLEXIGLASS
76"
(1930)
FRONT DOOR
2.75" (70)

FRONT VIEW


A
COOLING FAN
REAR DOOR
SIDE PANEL
A

REAR VIEW

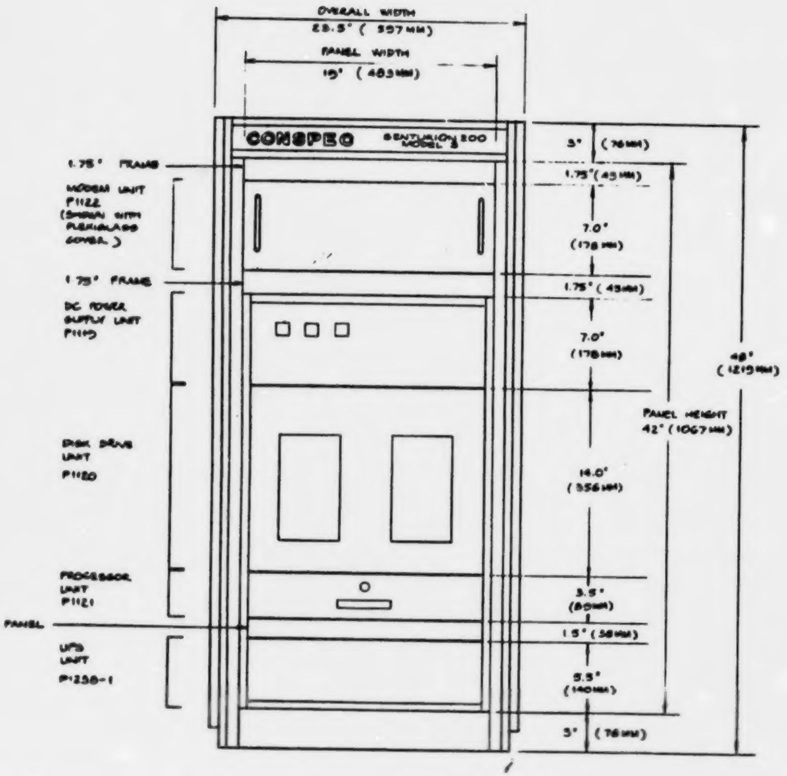
REFERENCE

PART NO	ITEM	DRAWINGS ASSY	DRAWINGS WIRING
P1122	MODEM UNIT	10063 SHT 1B	
	LOCAL TRUNK DRIVER WITH TIME OF DAY MODULE	10288 SHT 3	10225
P1119	DC POWER SUPPLY UNIT	10283	10282
P1120	DISK DRIVE UNIT	10281	10280
P1121	PROCESSOR UNIT	10286	10285

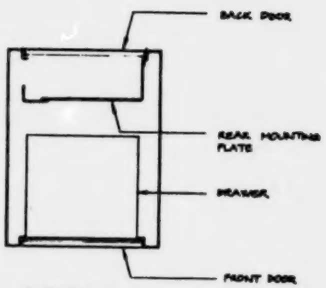
CONSPEC
SENTURION 200-MODEL 5.5D
SYSTEM ASSEMBLY DWG
70" SUPERLINE CABINET
BW ~
83-3-24
10052
SHT 1B OF 2

REV	ECN
A	
B	
C	
D	
E	

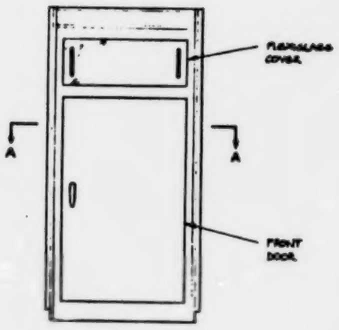
ISSUE


OVERALL WIDTH
23.5" (597MM)
PANEL WIDTH
19" (483MM)
CONSPEC
CENTURION 200 MODEL 3
1.75" FRAME
MODEM UNIT
P1122
(SHOWN WITH
PLEXIGLASS
COVER)
1.75" FRAME
DC POWER
SUPPLY UNIT
P1119
DISK DRIVE
UNIT
P1120
PROCESSOR
UNIT
P1121
19" PANEL
UPS
UNIT
P1238-1
3" (76MM)
1.75" (45MM)
7.0" (178MM)
1.75" (45MM)
7.0" (178MM)
14.0" (356MM)
3.5" (89MM)
1.5" (38MM)
5.5" (140MM)
3" (76MM)
PANEL HEIGHT
42" (1067MM)
48" (1219MM)

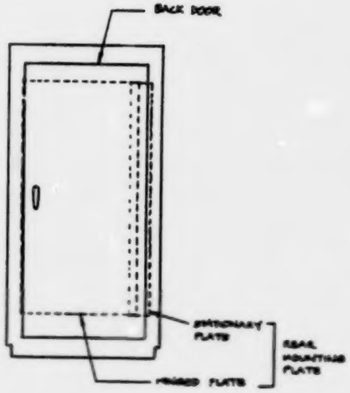
FRONT VIEW
(DOOR NOT SHOWN)
DEPTH : 30" (762 MM)
STANDING HEIGHT : 51.75" (1315 MM)
(ON CASTERS)


BACK DOOR
REAR MOUNTING PLATE
DRAWER
FRONT DOOR

SECTION A-A

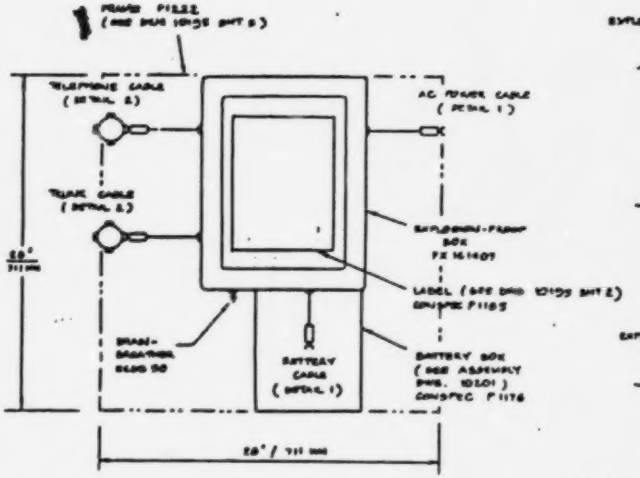

FIBERGLASS COVER
FRONT DOOR
A
A

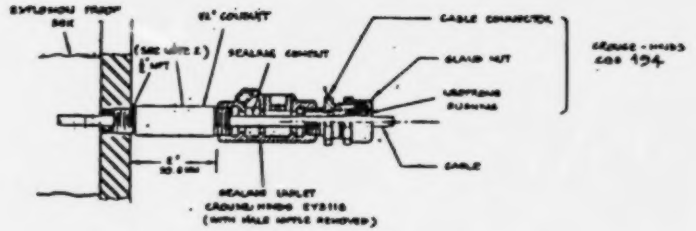
FRONT VIEW


BACK DOOR
STATIONARY PLATE
HINGED PLATE
REAR MOUNTING PLATE

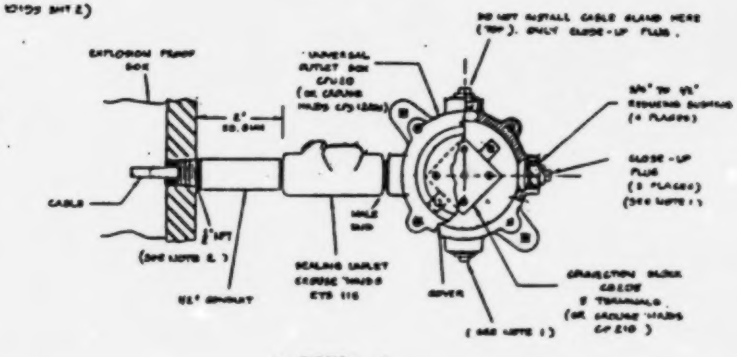
REAR VIEW

PART NO
CONSPEC
CENTURION 200-MODEL 3D
SYSTEM ASSEMBLY DRAWING
42" SUPERLINE CABINET
DWN NTS
10-2-81
10052
SHT 1 OF 2


FRAME P1222
(SEE DWG 10155 SHT 2)
TELEPHONE CABLE
(DETAIL 2)
TRUNK CABLE
(DETAIL 2)
AC POWER CABLE
(DETAIL 1)
EXPLOSION-PROOF BOX
FX 161407
LABEL (SEE DWG 10155 SHT 2)
CONSPEC P1185
BATTERY CABLE
(DETAIL 1)
BATTERY BOX
(SEE ASSEMBLY DWG. 10201)
CONSPEC P1176
28"/711 mm


EXPLOSION PROOF BOX
1/2" CONDUIT
SEALING CEMENT
CABLE CONNECTOR
GLAND NUT
CABLE
CROUSE-HINDS CGB 194
(SEE NOTE 2)
1/2" NPT
2" 50.8mm
SEALING UNILET
CROUSE-HINDS EYS116
(WITH MALE NIPPLE REMOVED)

A DETAIL 1


DO NOT INSTALL CABLE GLAND HERE
(TOP). ONLY CLOSE-UP PLUG.
EXPLOSION PROOF BOX
UNIVERSAL OUTLET BOX
(OR CROUSE HINDS)
3/4" TO 1/2" REDUCING BUSHING
(4 PLACES)
CLOSE-UP PLUG
(3 PLACES)
(SEE NOTE 1)
2" 50.8mm
CABLE
1/2" NPT
(SEE NOTE 2)
1/2" CONDUIT
SEALING UNILET
CROUSE HINDS
EYS 116
COVER
CONNECTION BLOCK
5 TERMINALS
(OR CROUSE HINDS CP 210)
(SEE NOTE 1)

A DETAIL 2

NOTES:

1- CABLE GLAND TO BE ADDED ON SITE TO ALLOW FOR CABLE ENTRY. USE CROUSE HINDS CGB 193 - BUSH 85.

2- ALLOW ENTERING CONDUIT AT LEAST FIVE FULL THREADS ENGAGED INTO BOX FOR EXPLOSION PROOF INTEGRITY.

3- ALL EXPOSED COMPONENTS MUST BE OF NON-ALUMINUM CONSTRUCTION.

4- PART NO'S SHOWN IN THIS DRAWING ARE OF APPLETON ELECTRIC LTD. UNLESS OTHERWISE SPECIFIED.

5- FINAL ASSEMBLY MUST BE FIELD LOCATED IN AN AREA NOT SUBJECT TO PHYSICAL DAMAGE.

6- USE OF A DRIP SHIELD IS RECOMMENDED.

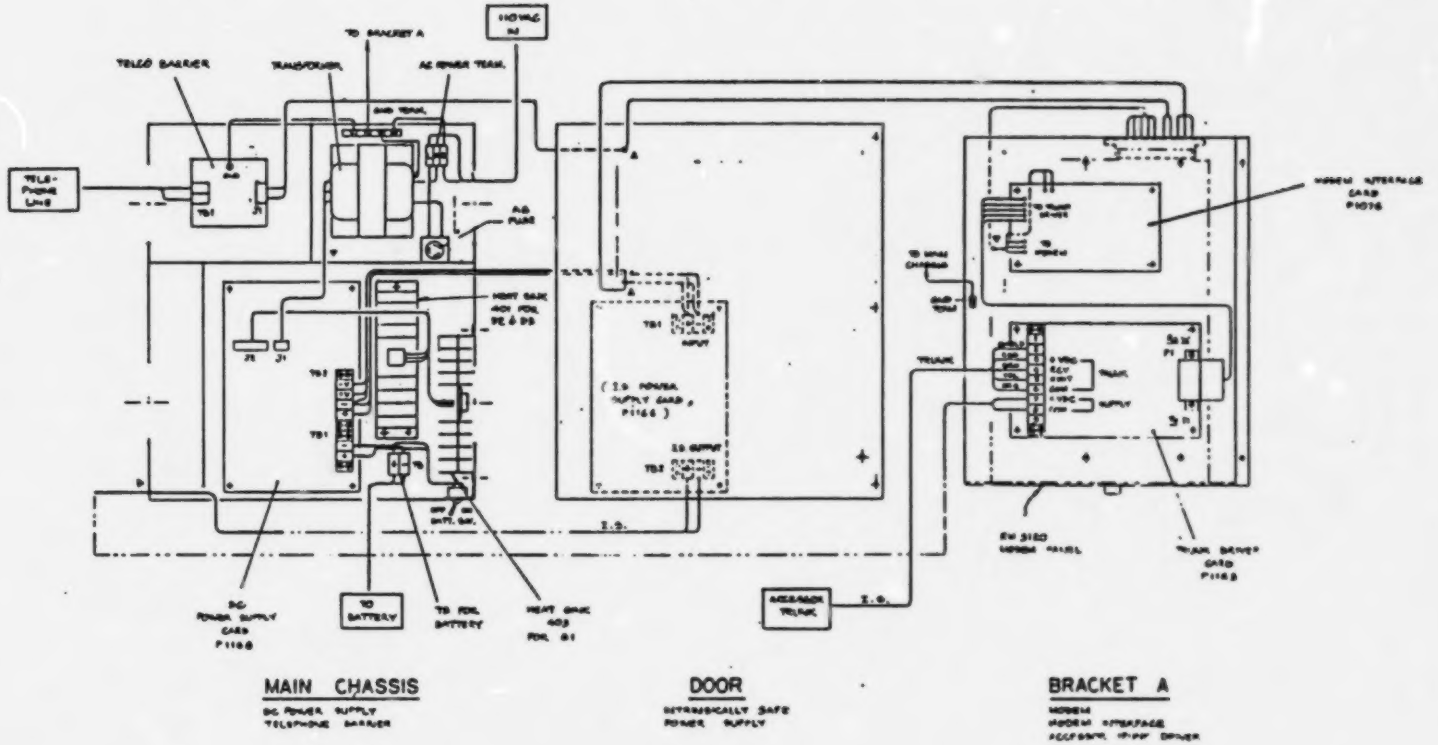
REVISIONS			
LTR	ECN	DATE	BY
A	1066	[illegible]	[illegible]
B	1104	[illegible]	[illegible]
C	1112	[illegible]	[illegible]
D	1152	[illegible]	[illegible]
E			

conspec

ASSEMBLY DRAWING
EXPLOSION PROOF BO
CABLE FITTINGS

PART NO. P1188

1020


TELCO BARRIER
TRANSFORMER
TO BRACKET A
AC POWER TERM.
110VAC IN
GND TERM.
TELE-PHONE LINE
TB1
J1
AC FUSE
HEAT SINK 401 FOR D2 & D3
J2
J1
TB2
TB1
DC POWER SUPPLY CARD P1168
TO BATTERY
TO POL BATTERY
HEAT SINK 403 FOR Q1
I.S.
(I.S. POWER SUPPLY CARD, P1166)
TB1
INPUT
I.S. OUTPUT
TB2
ACCESSOR TRUNK
TRUNK
TO MAIN CHASSIS
GND TERM
TO TRUNK DRIVER
TO MODEM
MODEM INTERFACE CARD P1076
TRUNK
SUPPLY
TRUNK DRIVER CARD P1163
RM 3120 MODEM PANEL
MAIN CHASSIS
DC POWER SUPPLY
TELEPHONE BARRIER
DOOR
INTRINSICALLY SAFE
POWER SUPPLY
BRACKET A
MODEM
MODEM INTERFACE
ACCESSOR TRUNK DRIVER

A THROUGH HOLE FOR CABLE

REVISIONS			
LTR	ECN	DATE	BY
A	1112	81-10-25	BV
B	1117	81-10-30	BV
C			
D			
E			

conspec

INT. ASSEMBLY DRAWING
REMOTE TRUNK DRIVER

10197

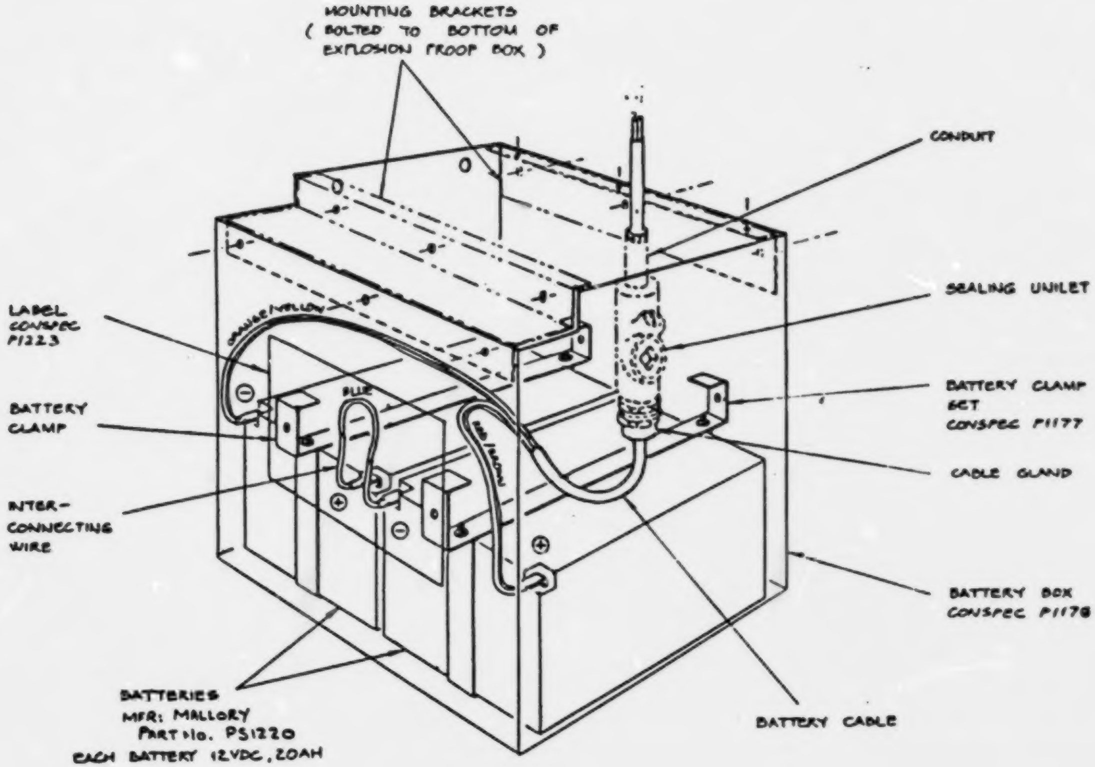
NOTES :

NON-ALUMINUM CONSTRUCTION.

2- SERVICE BY AUTHORIZED PERSONNEL ONLY

3- SERVICE ONLY WHEN SAFE (NON GASSY) CONDITION PREVAIL.

4- INSTALL IN AREA NOT SUBJECT TO PHYSICAL DAMAGE.


MOUNTING BRACKETS
(BOLTED TO BOTTOM OF EXPLOSION PROOF BOX)
CONDUIT
SEALING UNILET
BATTERY CLAMP SET CONSPEC P1177
CABLE GLAND
BATTERY BOX CONSPEC P1178
BATTERY CABLE
LABEL CONSPEC P1223
BATTERY CLAMP
INTER-CONNECTING WIRE
ORANGE/YELLOW
BLUE
RED/BROWN
⊕
⊖
BATTERIES
MFR: MALLORY
PART NO. PS1220
EACH BATTERY 12VDC, 20AH

BATTERY BOX ASSEMBLY

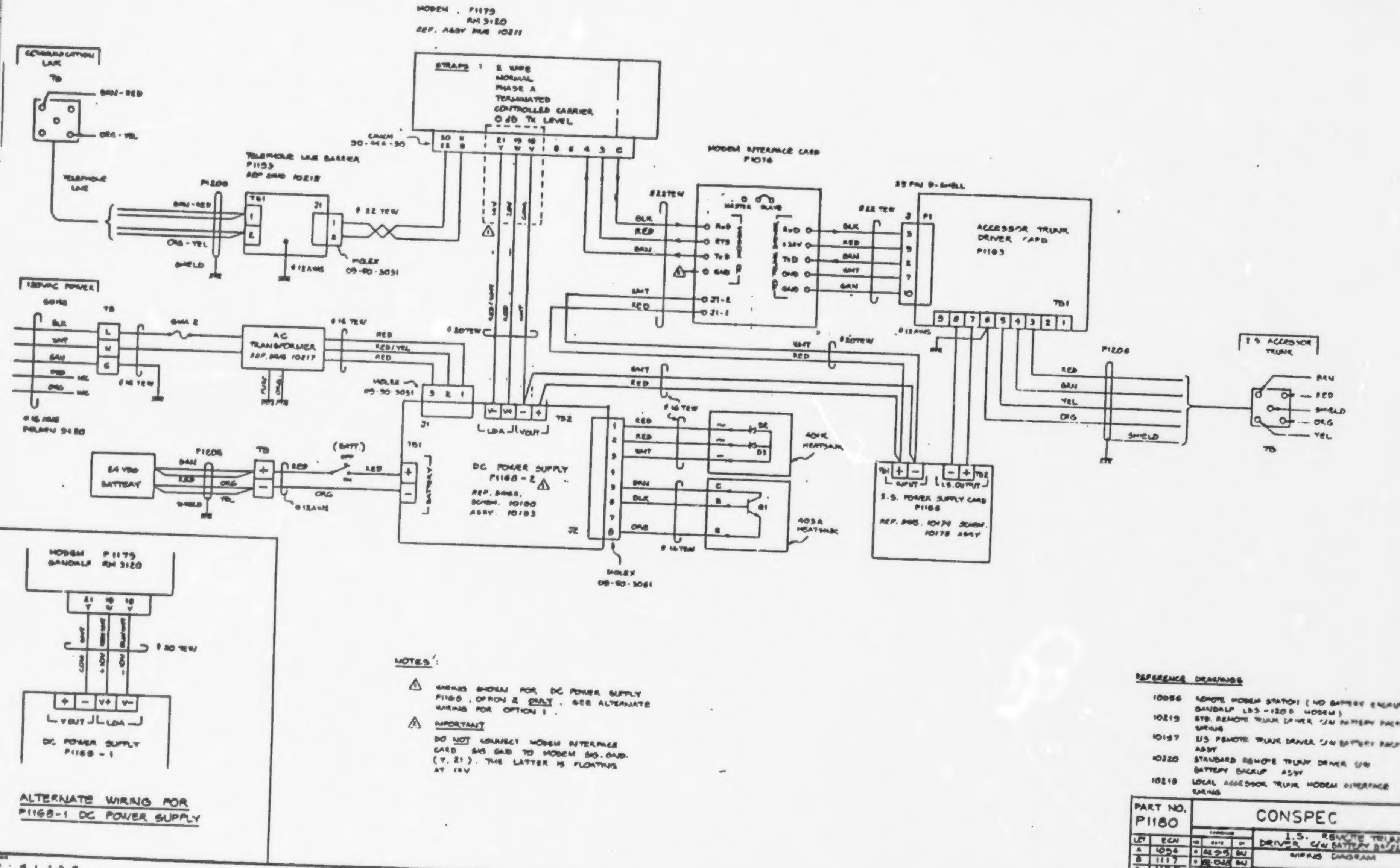
REFERENCE DWGS :

- 10200 : CABLE CLAMP ASSY.
- 10198 (SHT 1) : BATTERY BOX & CLAMP SET DETAIL DRAWING
- 10198 (SHT 2) : LABEL FOR BATTERY BOX

REVISIONS			
LET	ECN	DATE	BY
A	1086	82-8-4	BN
B	1112	82-10-5	BN
C	111C	82-10-15	BN

CONSPEC	
ASSEMBLY DWG BATTERY BOX	
PART NO. P1186	
DRN BN 82-7-22	JOB NO.
CHKD LMM APP HHH	DRAWING NO. 10201
SCALE NONE	SHEET 1 OF 1

ISSUE : 0 1 2 3


MODEM . P1179
RM 3120
REF. ASSY DWG 10211
STRAPS 1 2 WIRE
NORMAL
PHASE A
TERMINATED
CONTROLLED CARRIER
0 dB TX LEVEL
CANNON
30-44A-30
20 11
21 Y
19 W
18 V
8 6 4 3 C
COMMUNICATION LINE
TB
BRN-RED
ORG-YEL
TELEPHONE LINE
P1206
TELEPHONE LINE BARRIER
P1153
REF DWG 10218
TB1
J1
#22 TEW
SHIELD
#12AWG
MOLEX
09-50-3031
MODEM INTERFACE CARD
P1076
MASTER SLAVE
#22TEW
BLK
RED
BRN
RxD
RTS
TxD
GND
J1-2
J1-1
RxD
+24V
TxD
GND
GND
WHT
RED
25 PIN D-SHELL
P1
3
5
2
7
10
ACCESSOR TRUNK
DRIVER CARD
P1103
TB1
9 8 7 6 5 4 3 2 1
#12AWG
#20TEW
120VAC POWER
60HZ
TB
L
N
G
BLK
WHT
GRN
RED NC
ORG NC
#16 AWG
BELDEN 9420
#16 TEW
GMA 2
AC TRANSFORMER
REF. DWG 10217
RED
RED/YEL
RED
PUR
ORG
MOLEX
09-50-3031
3 2 1
J1
V- V+ - +
LDA VOUT
TB2
TB1
DC POWER SUPPLY
P1168-2
REF. DWGS.
SCHEM. 10100
ASSY. 10103
BATTERY
J2
MOLEX
09-50-3061
24 VDC
BATTERY
P1206
BRN
RED
ORG
YEL
SHIELD
TB
(BATT.)
OFF
ON
#12AWG
1 2 3 4 5 6 7 8
#16TEW
RED
RED
WHT
BRN
BLK
ORG
D2
D3
401R
HEATSINK
C
B
E
Q1
403A
HEATSINK
TB1
INPUT
I.S. OUTPUT
TB2
I.S. POWER SUPPLY CARD
P1166
REF. DWG. 10179 SCHEM.
10178 ASSY
P1206
RED
BRN
YEL
ORG
SHIELD
I.S. ACCESSOR TRUNK
BRN
RED
SHIELD
ORG
YEL
TB
MODEM P1179
GANDALF RM 3120
21 Y
19 W
18 V
WHT
COM
+10V
-10V
#20 TEW
+ - V+ V-
VOUT LDA
DC POWER SUPPLY
P1168-1

ALTERNATE WIRING FOR
P1168-1 DC POWER SUPPLY

NOTES:

1. WIRING SHOWN FOR DC POWER SUPPLY P1168, OPTION 2 ONLY. SEE ALTERNATE WIRING FOR OPTION 1.
2. IMPORTANT
DO NOT CONNECT MODEM INTERFACE CARD SIG GND TO MODEM SIG. GND. (Y, 21). THE LATTER IS FLOATING AT 14V

REFERENCE DRAWINGS

10056	REMOTE MODEM STATION (NO BATTERY BACKUP, GANDALF LDS-120B MODEM)
10219	STD. REMOTE TRUNK DRIVER C/W BATTERY BACKUP WIRING
10197	I/S REMOTE TRUNK DRIVER C/W BATTERY BACKUP ASSY
10220	STANDARD REMOTE TRUNK DRIVER C/W BATTERY BACKUP ASSY
10218	LOCAL ACCESSOR TRUNK MODEM INTERFACE WIRING

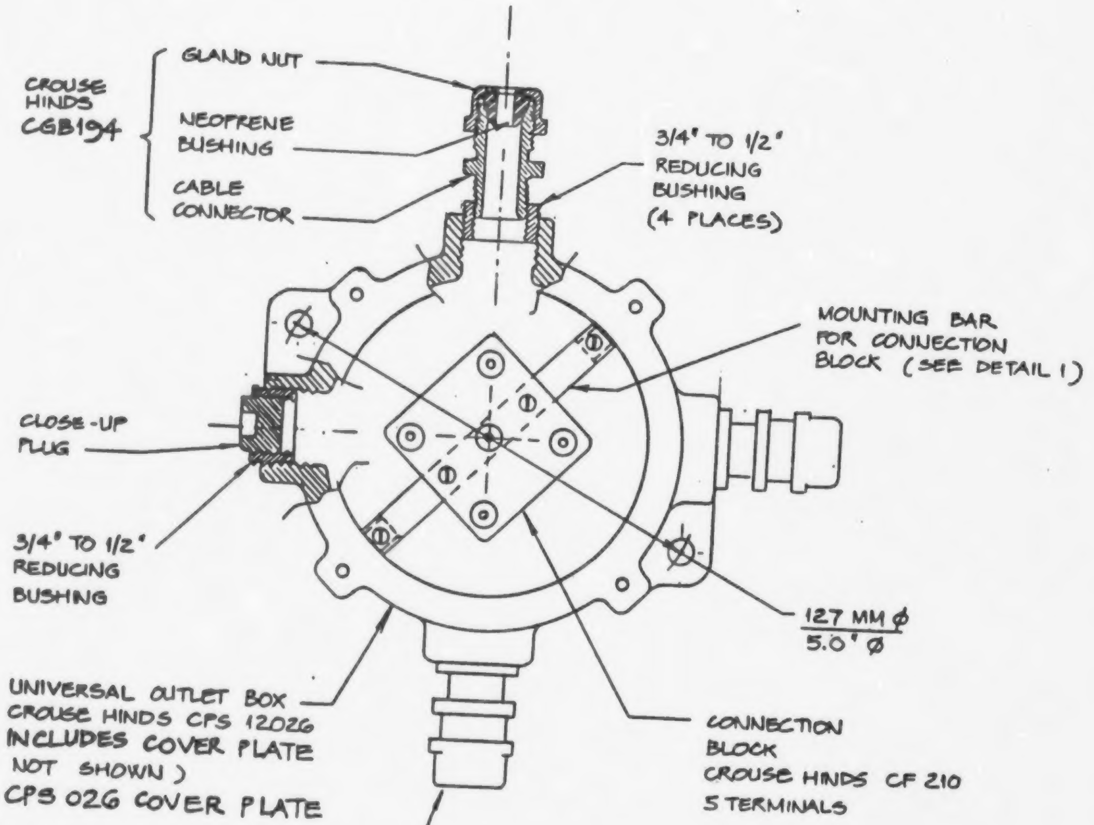
PART NO.
P1180

CONSPEC

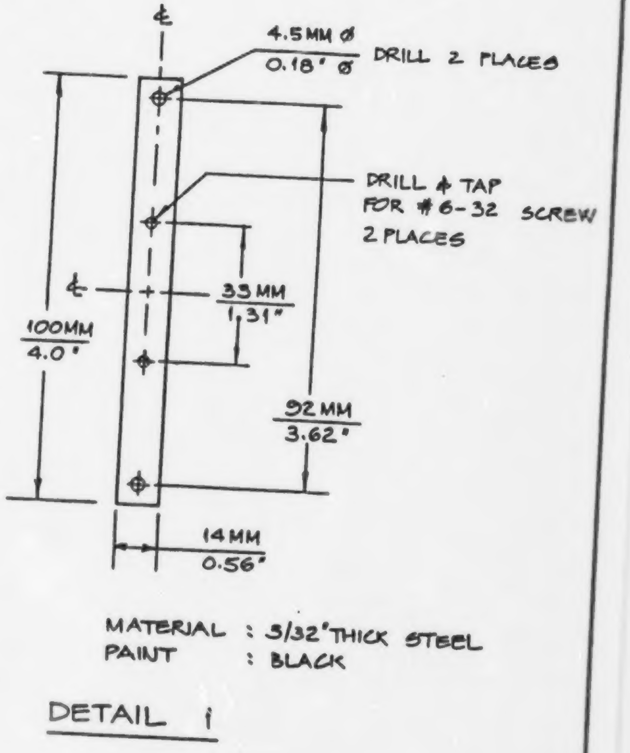
I.S. REMOTE TRUNK DRIVER C/W BATTERY BACKUP
WIRING DIAGRAM

LET	ECN			
A	1034	0	82-3-5	BW
B	1117	0	82-0-26	BW
C	1126	0	82-2-24	BK
D		0		
E		0		

BW
82-3-14
10196


CROUSE HINDS CGB194
GLAND NUT
NEOPRENE BUSHING
CABLE CONNECTOR
3/4" TO 1/2" REDUCING BUSHING (4 PLACES)
MOUNTING BAR FOR CONNECTION BLOCK (SEE DETAIL 1)
CLOSE-UP PLUG
3/4" TO 1/2" REDUCING BUSHING
127 MM Ø
5.0" Ø
UNIVERSAL OUTLET BOX CROUSE HINDS CPS 12026 INCLUDES COVER PLATE NOT SHOWN)
CPS 026 COVER PLATE
CONNECTION BLOCK CROUSE HINDS CF 210 5 TERMINALS

3 PLACES FOR : — TRUNK IN CABLE
— TRUNK OUT CABLE
— INSTRUMENT CABLE


4.5 MM Ø
0.18" Ø
DRILL 2 PLACES
DRILL & TAP FOR #6-32 SCREW 2 PLACES
33 MM
1.31"
100MM
4.0"
92 MM
3.62"
14 MM
0.56"

MATERIAL : 3/32" THICK STEEL
PAINT : BLACK

DETAIL 1

NOTE : ALTERNATE PARTS :
- OUTLET BOX : APPLETON CPU 20
- CONNECTION BLOCK : APPLETON CB205
C/W MOUNTING BAR

REVISIONS			
LET	ECN	DATE	BY
A	1132	83-3-29	BN

CONSPEC
SCALE: NTS
DATE: 82/9/22
APPROVED BY: M.H.M.
DRAWN BY BVN
REVISED
ACCESSOR TRUNK SPLITTER BOX
PART NO. P1211
DRAWING NUMBER 10231

ISSUE : 01 A

ACCESSOR TYPE	PART NUMBER	FIELD WIRING DRAWING	ENCLOSURE : S - SINGLE D - DUAL	BAG CONTENTS TERMINAL BLOCK 2 POSITIO	" 3 " "	" 4 " "	" 5 " "	" 6 " "	" 7 " "	" 8 " "	" 9 " "	" 10 " "	MOUNTING SCREWS	" WASHERS	" LOCKWASHERS	SNAPTRACKS	PUSH-ON TAB CONNECTORS	STAND-OFFS
ANALOGS A50, A51, A54, A55, A58 A61–A64, A67, A69		10207	S	–	1	–	1	–	–	–	–	–	6	6	6	1	7	–
ANALOGS A52, A53, A56, A57, A59, A60, A65, A66 A68		10207	S	–	–	1	1	–	–	–	–	–	6	6	6	1	7	–
B1	P1293		S	–	1	–	1	–	–	–	–	–	6	6	6	1	7	–
B2 *	P1294		S	–	–	–	2	–	–	–	–	–	6	6	6	1	9	–
B2 SRP *	P1296		S	–	1	–	1	–	–	–	–	–	6	6	6	1	8	–
B2 / B2 SRP *	P1189	10203	D	–	1	–	2	–	–	–	–	–	10	10	10	2	12	–
B20	P1298	10158	D	–	1	–	1	–	–	–	–	–	4	4	4	–	7	4
B21	P1056	10153	S	–	1	–	1	–	–	–	–	–	6	6	6	1	7	–
B22 *																		
B24	P1054-0	10154	S	–	–	–	1	–	–	1	–	–	6	6	6	1	9	–
B24 CHASSIS MOUNT	P1054-1	10199	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
B24 DUAL ASSY.	P1151	10213	D	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
B24 / B22 SRP	P1150	10204	D	–	–	–	1	–	–	1	–	–	8	8	8	2	12	–
B25 *	P1007	10155	S	–	–	–	1	–	1	–	–	–	6	6	6	1	11	–
B25 SRP *	P1097	10147	S	1	–	–	–	–	1	–	–	–	6	6	6	1	9	–
B25 / B25 SRP	P1231	10238	D	1	–	–	1	–	–	–	–	–	8	8	8	2	6	–
B30 B20 MODIFIED FOR 24VDC	P1232	10158	D	1	–	–	1	–	–	–	–	–	4	4	4	–	7	4
C3	P1173	10205	S	–	1	–	1	–	–	–	–	–	6	6	6	1	7	–
C5	P1251	10251	S	–	1	–	1	–	–	–	–	–	6	6	6	1	7	–
D1	P1279	10206	S	–	1	–	1	–	–	–	–	–	6	6	6	1	7	–

* APPLICATION DEPENDENT. SEE ENGINEERING. NUMBERS SHOWN ARE TYPICAL.

ISSUE : 0 A

ASSEMBLY INSTRUCTIONS FOR ACCESSOR ENCLOSURES

① REFER TO THE TABLE FOR THE ACCESSOR FIELD WIRING DIAGRAM.

② A PLASTIC PARTS BAG IS ENCLOSED. SEE THE TABLE FOR A LIST OF CONTENTS.

③ ASSEMBLE 4 TABS ON ACCESSOR TRUNK TERMINAL BLOCK.

NOTE : THE FIFTH POSITION IS FOR TERMINATING THE ACCESSOR TRUNK SHIELD WHICH MUST NOT BE CONNECTED TO CHASSIS OR ANY LOCAL GROUND. THE INSTALLER MUST INSULATE THE BARE SHIELD WIRE WITH TAPE.

④ ASSEMBLE TABS ON 'LOAD' AND 'LOCAL POWER SUPPLY' TERMINAL BLOCKS AS REQUIRED.

⑤ ASSEMBLE SNAPTRACK WITH SCREWS INTO PREDRILLED AND TAPPED HOLES.

⑥ ASSEMBLE TERMINAL BLOCKS WITH SCREWS INTO PREDRILLED AND TAPPED HOLES. TABS FACE TOWARD SNAPTRACK.

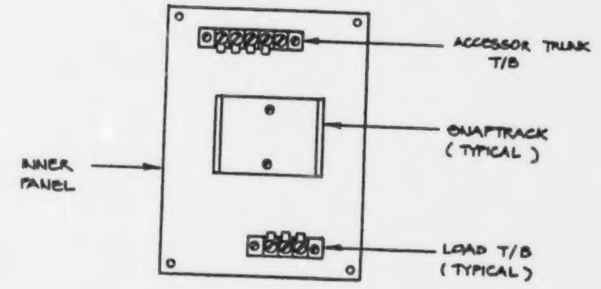
⑦ FIX ADHESIVE LABEL IN PLACE. REFER TO FIELD WIRING DIAGRAM TO ENSURE CORRECT ORIENTATION.

⑧ CONNECT TRUNK STUB CABLE(S) AND LOAD CABLES TO TERMINAL BLOCK TABS. VERIFY COLOUR CODING AND ORIENTATION WITH FIELD WIRING DRAWING.

⑨ CONNECT FIELD WIRING AND TEST POINT-TO-POINT. APPLY POWER AND CHECK VOLTAGE LEVEL AND POLARITY. REMOVE POWER.

⑩ MOUNT ACCESSOR ON SNAPTRACK AND CONNECT TO CABLES.

CAUTION : OBSERVE POLARITY MARKINGS ON CONNECTORS.



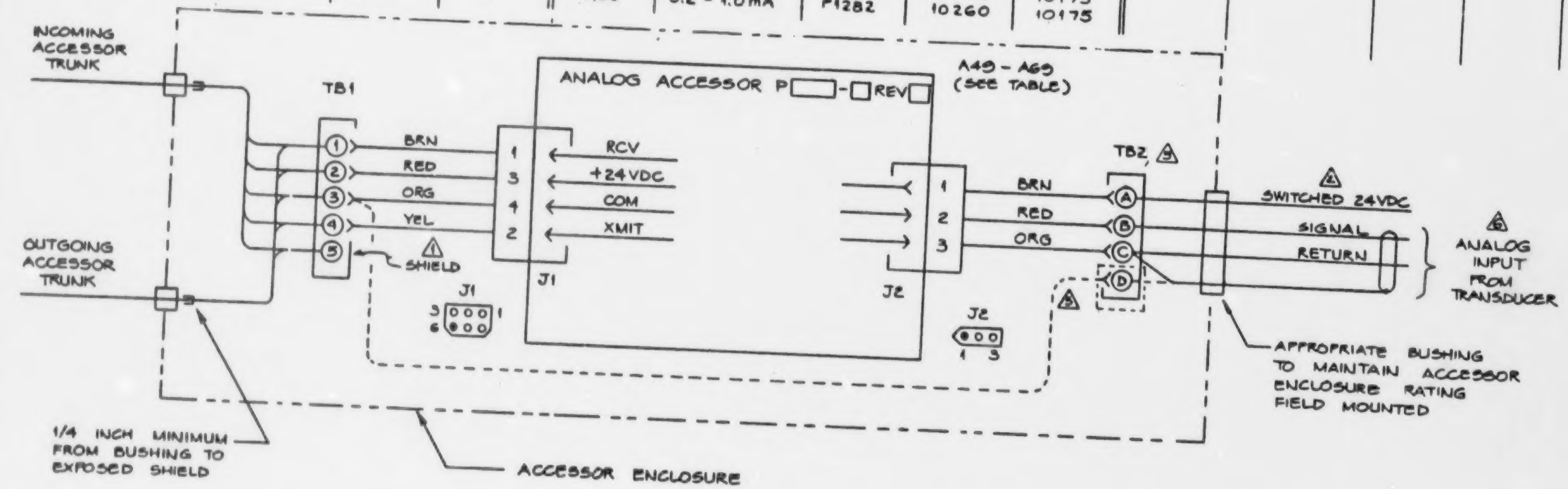
REVISIONS			
LTR	ECN	DATE	BY
A	–	83-3-1	BN

CONSPEC

ASSEMBLY INSTRUCTIONS FOR ACCESSOR ENCLOSURES

DRN BN 82-11-03
SCALE ~
DRAWING NO. 10237
SHEET 1 OF 1
REV A

ACCESSOR	FUNCTION	PART NO	ASSY. DWG.	SCHEMATIC
A49	·	P1153	10230	10175
A50	0 - 1V	P1154	10187	"
A51	0 - 10 V	P1155	10188	"
A52	0 - 5mA	P1156	10189	"
A53	0 - 20mA	P1157	10190	"
A54	1 - 5V	P1158	10186	"
A55	0 - 5V	P1151	10176	"
A56	4 - 20mA	P1159	10177	"
A57	1 - 5mA	P1160	10181	"
A58	0.2 - 1V	P1161	10185	10175
A59	1 - 0V	P1162	10182	"
A60	0-1V (DIFF.)	P1197	10222	"
A61	0.5 - 1.5V	P1202	10226	"
A62	0.4 - 2.0V	P1280	10258	"
A63	RTD -30°F TO 150°F	P1198	10224	10223
A64	RTD 90°F TO 270°F	P1199	10224	10223
A65	0 - 1 mA	P1281	10259	10175
A66	0.2 - 1.0mA	P1282	10260	10175
A67	RTD 210°F TO 370°F	P1200	10224	10223
A68	1 - 0mA	P1283	10261	10175
A69	0 - 100mV	P1284	10262	10175


INCOMING ACCESSOR TRUNK
OUTGOING ACCESSOR TRUNK
TB1
① ② ③ ④ ⑤
BRN
RED
ORG
YEL
⚠1 SHIELD
J1
1 3 4 2
3 6 1
ANALOG ACCESSOR P☐-☐REV☐
A49 - A69 (SEE TABLE)
RCV
+24VDC
COM
XMIT
J2
1 2 3
1 3
TB2, ⚠5
BRN
RED
ORG
Ⓐ Ⓑ Ⓒ Ⓓ
⚠5
⚠2 SWITCHED 24VDC
SIGNAL
RETURN
⚠6 ANALOG INPUT FROM TRANSDUCER
APPROPRIATE BUSHING TO MAINTAIN ACCESSOR ENCLOSURE RATING FIELD MOUNTED
1/4 INCH MINIMUM FROM BUSHING TO EXPOSED SHIELD
ACCESSOR ENCLOSURE

FIELD WIRING DIAGRAM FOR ANALOG ACCESSORS A49 - A69

NOTES :

⚠1 TRUNK SHIELD MUST NOT BE CONNECTED TO ANY LOCAL GROUND. INSTALLER MUST INSULATE BARE SHIELD WITH TAPE.

⚠2 +24VDC IS AVAILABLE AT J2, PIN 1 TO POWER LOADS IN ALL ANALOGS EXCEPT A63, A64, A67. OPTIONAL ON-BOARD CIRCUITRY PERMITS REMOTE SWITCHING OF POWER TO THE LOAD VIA ACCESSOR COMMANDS.

⚠3 SIGNAL WIRING FROM ACCESSOR TO TRANSDUCER SHOULD BE A # 18 AWG TWISTED SHIELDED PAIR. DO NOT CONNECT THE SHIELD AT THE TRANSDUCER.

⚠4 MAXIMUM DISTANCE FROM ACCESSOR TO TRANSDUCER IS AS FOLLOWS :

ACCESSOR	DISTANCE
A60, A63, A64, A67, A69	100FT (30M)
A50, A51, A54, A55, A58, A59, A61, A62	500FT (150M)
A52, A53, A56, A57, A65, A66, A68	1000FT (300M)

⚠5 FOR DIFFERENTIAL INPUT ACCESSORS A52, A53, A56, A57, A59 A60, A65, A66, A68 :

A - INSTALL A 4 POSITION TB2 INSTEAD OF 3 POSITION.

B - CONNECT SHIELD TO TB2-D INSTEAD OF TB2-C.

C - ADD A # 18 AWG ORANGE WIRE BETWEEN TB1-3 AND TB2-D.

⚠6 INTRINSICALLY SAFE APPLICATIONS :

TRANSDUCERS OR OTHER PERIPHERAL DEVICES MAY NOT BE CONNECTED TO THE ACCESSOR UNLESS THEY ARE CERTIFIED BY THE REGULATORY AUTHORITY.

COMMANDS	BIT		6	5	4	3	2	1	0	
- SEND BACK I.D. AND INPUT VALUE			0	0	x	1	0	0	0	(x = DON'T CARE)
- SWITCH OFF 24 VDC			0	0	0	x	0	0	0	⚠2
- SWITCH ON 24 VDC			0	0	1	x	0	0	0	⚠2
RESPONSES	**BIT**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**	
- ≤ MINIMUM VALUE		0	0	0	0	0	0	0	0	
- ≥ FULL SCALE		1	1	1	1	1	1	1	1	

REVISIONS			
LET	ECN	DATE	BY
A	1100	82-9-30	BN
B	—	82-10-14	BN

REFERENCE DWGS.
SEE TABLE

JOB NO.

conspec

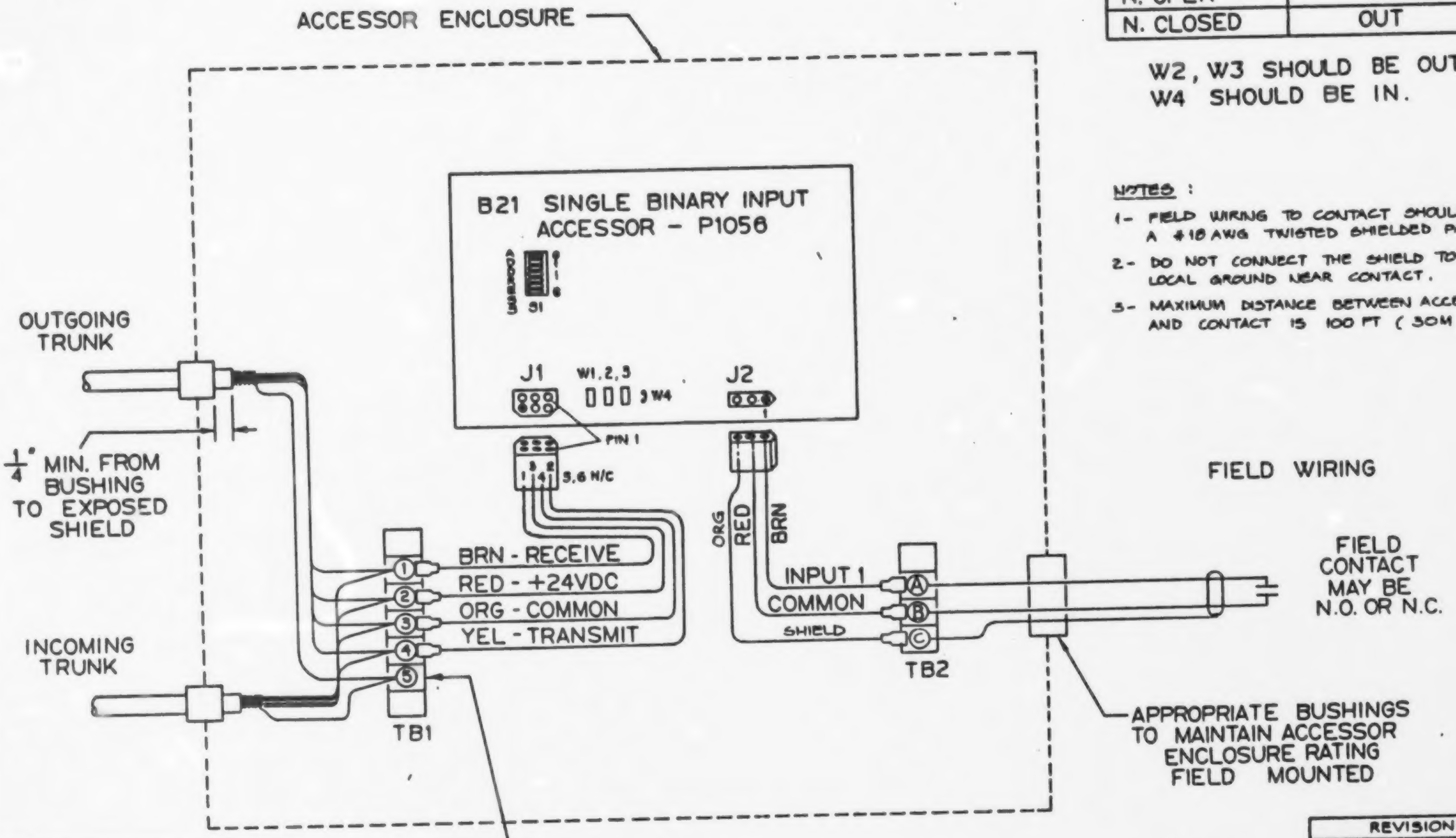
FIELD WIRING DIAGRAM
FOR ANALOG ACCESSORS
A49 - A69

DWN BVN 82-7-29
CHKD
APPD
SCALE ~
DRAWING NO.
10207
SHEET 1 OF 1

ISSUE : Ø 1 2

CONTACT	JUMPER W1
N. OPEN	IN
N. CLOSED	OUT

W2, W3 SHOULD BE OUT.
W4 SHOULD BE IN.


ACCESSOR ENCLOSURE
B21 SINGLE BINARY INPUT ACCESSOR - P1056
S1
J1
W1,2,3
W4
J2
PIN 1
5,6 N/C
OUTGOING TRUNK
1/4" MIN. FROM BUSHING TO EXPOSED SHIELD
INCOMING TRUNK
BRN - RECEIVE
RED - +24VDC
ORG - COMMON
YEL - TRANSMIT
TB1
ORG
RED
BRN
INPUT 1
COMMON
SHIELD
TB2
FIELD WIRING
FIELD CONTACT MAY BE N.O. OR N.C.
APPROPRIATE BUSHINGS TO MAINTAIN ACCESSOR ENCLOSURE RATING FIELD MOUNTED

SHIELD MUST NOT BE CONNECTED
TO ANY LOCAL GROUND
INSTALLER MUST INSULATE BARE
SHIELD WITH TAPE

NOTES :

1- FIELD WIRING TO CONTACT SHOULD BE A #18 AWG TWISTED SHIELDED PAIR.
2- DO NOT CONNECT THE SHIELD TO ANY LOCAL GROUND NEAR CONTACT.
3- MAXIMUM DISTANCE BETWEEN ACCESSOR AND CONTACT IS 100 FT (30M).

COMMAND		6	5	4	3	2	1	0
SEND STATUS		0	0	0	1	0	0	0
RESPONSE	7	6	5	4	3	2	1	0
OPEN CONTACT	1	1	X	0	0	0	1	0
CLOSED CONTACT	1	1	X	0	0	1	1	0

WHERE X = 0 FOR W1 IN
(SET FOR N.O. CONTACT)
X = 1 FOR W1 OUT
(SET FOR N.C. CONTACT)

B21 ACCESSOR — FIELD WIRING DIAGRAM

REF. DWGS.
10060 SCHEMATIC
10081 ASSY

REVISIONS				
LET.	ECN	DATE	BY	
A	1047	82-01-29	BN	
B	1083	82-7-22	BN	—
C	1108	82-9-30	BN	—
D	–	83-3-21	BN	—

conspec

DRAWN BW DATE 81-12-30 APP'D

DWG. NO. 10153

ø 1 2 D

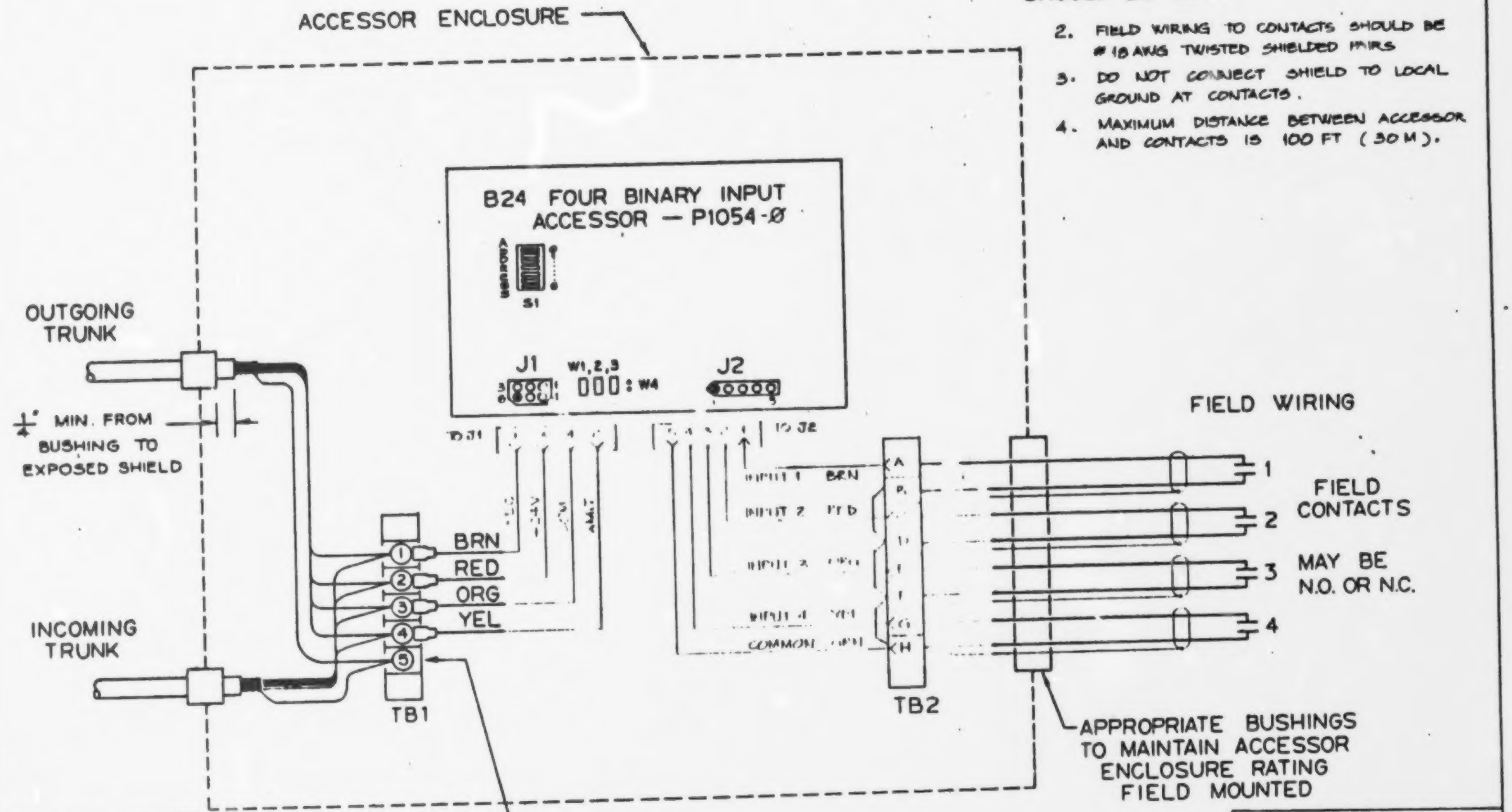
NOTES :

1 — JUMPERS W1, W2, W3 AND W4 SHOULD BE OUT.

2. FIELD WIRING TO CONTACTS SHOULD BE #18 AWG TWISTED SHIELDED PAIRS

3. DO NOT CONNECT SHIELD TO LOCAL GROUND AT CONTACTS.

4. MAXIMUM DISTANCE BETWEEN ACCESSOR AND CONTACTS IS 100 FT (30 M).


ACCESSOR ENCLOSURE
B24 FOUR BINARY INPUT ACCESSOR — P1054-0
S1
J1
W1,2,3
W4
J2
TO J1
TO J2
OUTGOING TRUNK
1/4" MIN. FROM BUSHING TO EXPOSED SHIELD
INCOMING TRUNK
BRN
RED
ORG
YEL
1
2
3
4
5
TB1
INPUT 1 BRN
INPUT 2 RED
INPUT 3 ORG
INPUT 4 YEL
COMMON
A
B
D
E
F
G
H
TB2
FIELD WIRING
1
2
3
4
FIELD CONTACTS
MAY BE N.O. OR N.C.
APPROPRIATE BUSHINGS TO MAINTAIN ACCESSOR ENCLOSURE RATING FIELD MOUNTED

SHIELD MUST NOT BE CONNECTED
TO ANY LOCAL GROUND
INSTALLER MUST INSULATE BARE
SHIELD WITH TAPE

COMMAND			C	5	4	3	2	1	0
SEND STATUS			0	0	0	1	0	0	0
RESPONSE		7	6	5	4	3	2	1	0
CONTACT 1	OPEN	1	1	1	0	x	x	x	0
	CLOSED	1	1	1	0	x	x	x	1
CONTACT 2	OPEN	1	1	1	0	x	x	0	x
	CLOSED	1	1	1	0	x	x	1	x
CONTACT 3	OPEN	1	1	1	0	x	0	x	x
	CLOSED	1	1	1	0	x	1	x	x
CONTACT 4	OPEN	1	1	1	0	0	x	x	x
	CLOSED	1	1	1	0	1	x	x	x
[illegible]		[illegible]							

B24 ACCESSOR — FIELD WIRING DIAGRAM

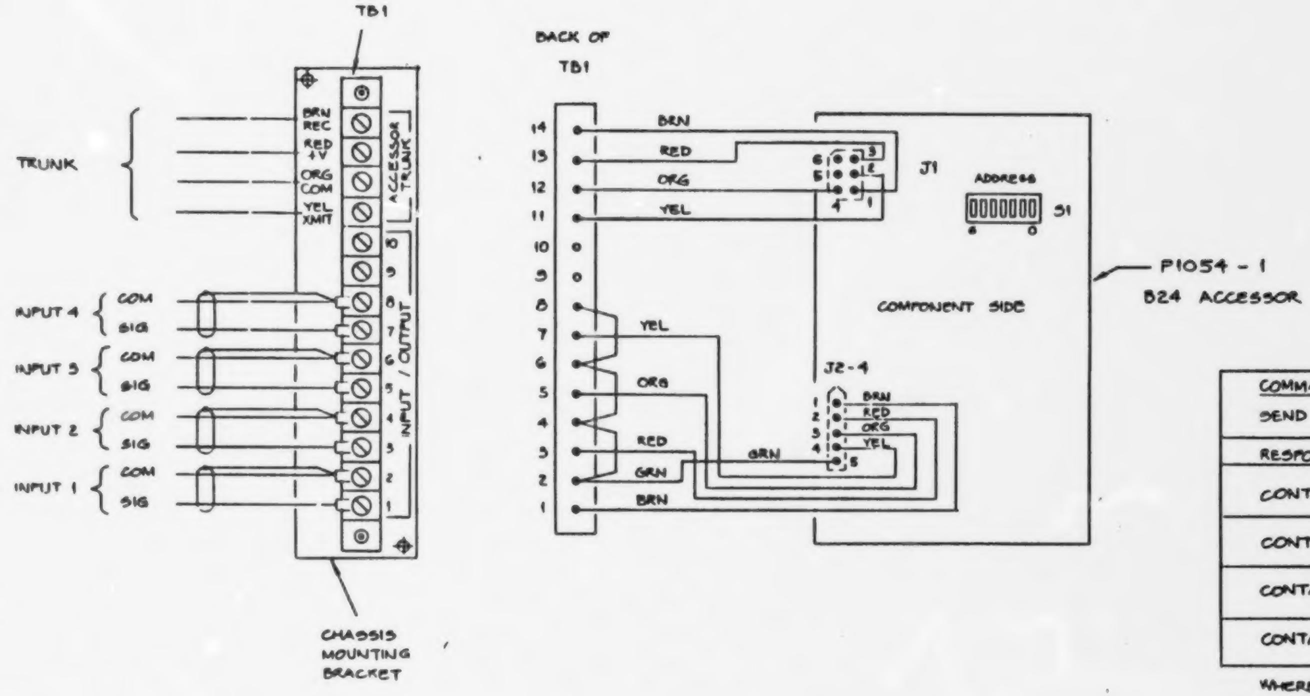
REF DWGS.
10058 SCHEMATIC
10059 ASSEMBLY

REVISION				
LET	ECN	DATE	BY	APP'D
A	—	—	—	—
B	1047	82-4-29	BN	
C	1083	82-7-22	BN	—
D	1108	82-9-30	RJ	—
E	—	83-3-01	BN	—

CONSOCC

DRAWN BN DATE 81-12-30 APP'D

DWG. NO. 10154


TB1
TRUNK
BRN REC
RED +V
ORG COM
YEL XMIT
ACCESSOR TRUNK
INPUT / OUTPUT
INPUT 4
INPUT 3
INPUT 2
INPUT 1
COM
SIG
1
2
3
4
5
6
7
8
9
10
CHASSIS MOUNTING BRACKET
BACK OF TB1
14
13
12
11
BRN
RED
ORG
YEL
GRN
J1
ADDRESS
S1
6
0
P1054 - 1
B24 ACCESSOR
COMPONENT SIDE
J2-4

COMMAND		6543210
SEND STATUS		0001000
RESPONSE		76543210
CONTACT 1	OPEN	1110XXX0
	CLOSED	1110XXX1
CONTACT 2	OPEN	1110XX0X
	CLOSED	1110XX1X
CONTACT 3	OPEN	1110X0XX
	CLOSED	1110X1XX
CONTACT 4	OPEN	11100XXX
	CLOSED	11101XXX

WHERE X = DON'T CARE

NOTES :

1- FIELD CONTACTS 1-4 MAY BE N.O. OR N.C.

2- FIELD WIRING SHOULD BE # 18 AWG TWISTED SHIELDED PAIRS.

3- DO NOT CONNECT SHIELDS TO LOCAL GROUNDS AT CONTACTS.

4- MAXIMUM DISTANCE BETWEEN ACCESSOR AND CONTACTS IS 100 FT (30 M).

5- JUMPERS W1, W2, W3, W4 SHOULD BE OUT

REVISIONS			
LET	ECN	DATE	BY
A	1108	82-9-30	BN
B	—	83-9-21	BN
C			
D			
E			

CUSTOMER'S REF.

REFERENCE DWGS.
10154 : B24 ACC FIELD WIRING DIAG.
10038 : B24 ACC SCHEM.
10059 : ASSY.

DRN BVN 82-7-20
CHKD
APPD
SCALE ~

conspec

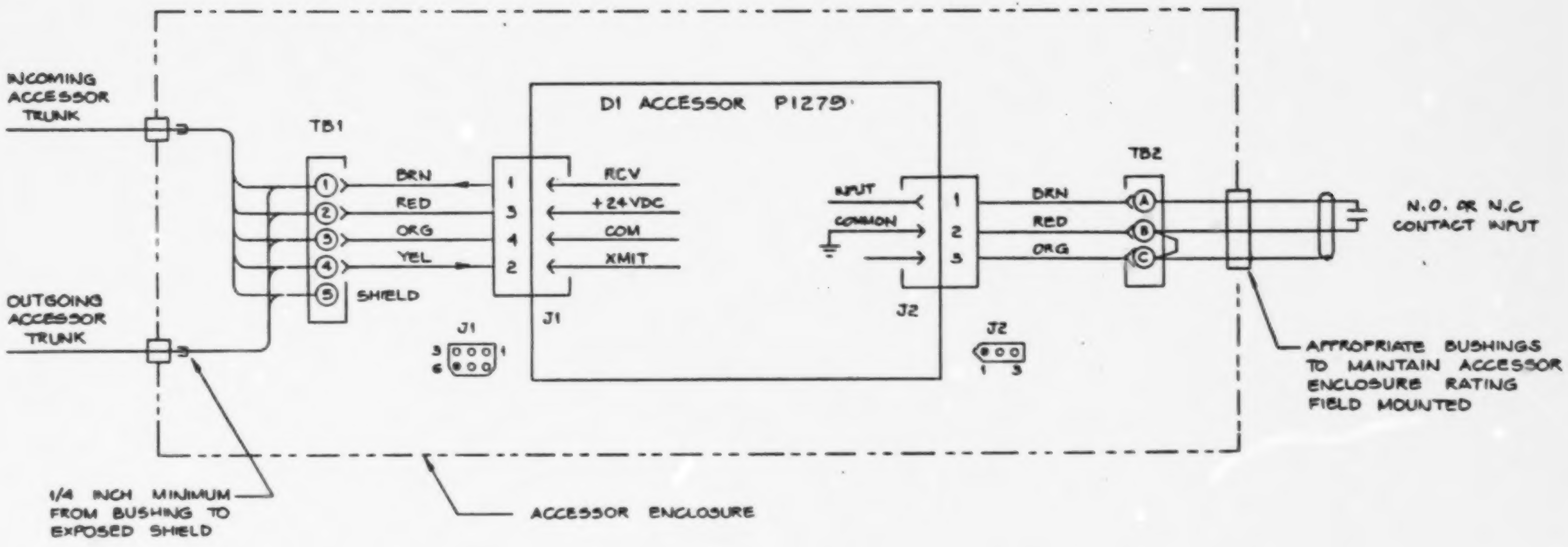
FIELD WIRING DIAGRAM FOR
B24 ACCESSOR
CHASSIS MOUNTED VERSION

PART NO : P1054 - 1

JOB NO.

DRAWING NO
10199
SHEET 1 OF 1

6 1 B


INCOMING ACCESSOR TRUNK
OUTGOING ACCESSOR TRUNK
TB1
①
②
③
④
⑤
SHIELD
BRN
RED
ORG
YEL
1
3
4
2
J1
J1
3
6
1
D1 ACCESSOR P1279
RCV
+24VDC
COM
XMIT
INPUT
COMMON
J2
1
2
3
J2
1
3
TB2
BRN
RED
ORG
Ⓐ
Ⓑ
Ⓒ
N.O. OR N.C CONTACT INPUT
APPROPRIATE BUSHINGS TO MAINTAIN ACCESSOR ENCLOSURE RATING FIELD MOUNTED
1/4 INCH MINIMUM FROM BUSHING TO EXPOSED SHIELD
ACCESSOR ENCLOSURE

FIELD WIRING DIAGRAM FOR D1 ACCESSOR (PULSE·ACCUMULATOR)

CONNECT JUMPERS AS FOLLOWS :

	W1	W2
COUNT PULSES	IN	OUT
COUNT CHANGES OF STATE	OUT	IN

COMMANDS	BIT 6	5	4	3	2	1	0
- SEND I.D.	0	0	0	1	0	0	0
- RESET COUNT	1	0	0	0	0	0	0
- SEND MOST SIGNIFICANT BYTE	0	0	0	0	0	1	0
- SEND LEAST SIGNIFICANT BYTE	0	0	0	0	0	0	1

RESPONSE STATUS	7	6	5	4	3	2	1	0
	X	X	X	X	X	X	X	X

(WHERE X = 1 OR 0)

NOTES:

1- TRUNK SHIELD MUST NOT BE CONNECTED TO ANY LOCAL GROUND. INSTALLER MUST INSULATE BARE SHIELD WITH TAPE.

2- CONTACT INPUT REQUIREMENTS :
  (A) PULSE DURATION .... 60 MS MINIMUM
  (B) PULSE RELEASE TIME .... 60 MS MINIMUM
  (C) MAX. PULSE RATE @ 50% DUTY CYCLE : 8 PULSES / SEC
  (D) MAXIMUM SENSOR DISTANCE .... 100 FT (30 M)
  (E) FIELD WIRING TO CONTACT SHOULD BE #18 AWG TWISTED SHIELDED PAIR.

REVISIONS			
LET	ECN	DATE	BY
A	–	83-3-21	BN

REFERENCE DWGS.

JOB NO.

conspec

FIELD WIRING DIAGRAM
D1 ACC. (PULSE ACCUMULATOR)

PART NO P1279

BY BWN 82-7-29

SCALE : ~

DRAWING NO. 10206
SHEET 1 OF 1

ISSUE : 0 1 2 A

APPENDIX B

ANALOG ACCESSOR CALCULATIONS

*** APPENDIX B -- ANALOG ACCESSOR CALCULATIONS

Data returned from analog accessors, depending on the accessor type, contain either one or two 8-bit bytes of digitized analog information. The computer processes these data for alarms and uses an 8-bit math routine to convert it to engineering units for printout and display. Initially, the user is required to calculate and enter parameters which the system uses to determine alarms and to convert accessor values to engineering units. These parameters may be saved as status on the disk and read into memory upon later startups. The basic equation used by the processor on the data returned is:

$FP = R(CF) + OFS$,

where FP = floating point value,

R = accessor value,

CF = correction factor,

and OFS = offset.

Accessor value represents the returned data from the 8-bit accessors or the best 8-bits from the 16-bit pulse-integrating accessors.

EIGHT-BIT ACCESSORS

To calculate the correction factor and offset the value to be displayed at the minimum and maximum inputs must be known, that is:

V_{min} = value to be displayed at low end of Accessor input range.

V_{max} = value to be displayed at high end of Accessor input range.

The correction factor and offset are calculated from these values as follows:

$$OFS = V_{MIN}\text{ , and}$$

$$CF = \frac{V_{MAX} - V_{MIN}}{255}$$

Alarm limits must be calculated in machine units for data entry reasons. These can be obtained by substituting desired engineering unit alarm limit values into equations A-4 and A-5 for FP and using the known CF and OFS to calculate the accessor value (R) as shown below:

$$FP = R_L(CF) + OFS\text{, and}$$

$$FP = R_H(CH) + OFS.$$

where R_L = low alarm limit in machine units,

and R_H = high alarm limit in machine units.

Values obtained for the alarm limits are rounded to the nearest whole number for machine entry purposes. A sample 8-bit analog calculation is shown below.

Sample 8-Bit Analog Calculation

An air velocity monitor is to be connected to measure the velocity of air flowing through a drift. Since the sensor has an analog voltage output, it is used with the A-50 Accessor. The following information is known:

a) The air velocity monitor output is from 0 to 5-v corresponding to air velocity. At 0-v output, air velocity = 0 fpm, at 5-v output, air velocity = 1,500 fpm (also a linear relationship exists).

b) The desired alarm limits are:

Low limit = 100 fpm
High limit = 1,000 fpm

1. CP and OFS

From equation A-3:

$$CF = \frac{V_{MAX} - V_{MIN}}{255} = \frac{1,500 - 0}{255} = 5.88$$

From equation A-2:

$OFS = V_{MIN} = 0.00$

2. Alarm limits

Low alarm (100 fpm)

From equation A-4:

$100 = R_L\ (5.88) + 0$:

$R_L = 17.$

High alarm

From equation A-5:

$1,000 = R_L\ (5.88) + 0$:

$R_H = 170.$

For machine entry, refer to data entry section.

APPENDIX C

SAMPLE PRINTOUTS

*** APPENDIX C. --- EXAMPLES OF PRINT ROUTINES

This appendix contains sample printouts of user-initiated print routines. The commands that initiate these routines are valid only in the main program mode.

Figure C-1 is an example of a trend log printout. The heading of the printout, which includes time and date, point numbers, and units, is generated by pressing the special key marked "TREND HDG." The processor then generates printouts of the current point values every 1 to 99 min. Both the point assignments and chosen time interval are entered with the LTT command prior to report generation.

Figure C-2 is an example of a portion of the accessor scan list printout. The printout will show all point assignments sorted by trunk number for all addresses. An asterisk next to the point number indicates that the point is presently in the scan. This printout is generated by the ACC command.

A descriptor list is shown in figure C-3. This routine prints out the point number, descriptor, and other information entered with the NEW command. Other information printed from left to right are:

1. PDH - user responses to print, display and horn on alarm queries in data entry.
2. TYP - accessor type code given in table 1.
3. M3/UN - mode 3-4 code for binary points or engineering units code for analog points.
4. M2 - mode 1-2 units code for binary points.
5. TR - trunk number of point.

6. ADDR - address of point.

This printout is initiated by the DSS command.

An analog parameters list printout is shown in figure C-4. This report shows all the analog scaling, alarm limits, delay to alarm and units code selections for each analog point in the system. This printout is generated by the PAP command.

A CF-OFS table is shown in figure C-5. In this print routine, the user specifies the desired range of reference numbers prior to the printout. The machine-entered value is then printed adjacent to its decimal equivalent. This printout is generated by the PCO command.

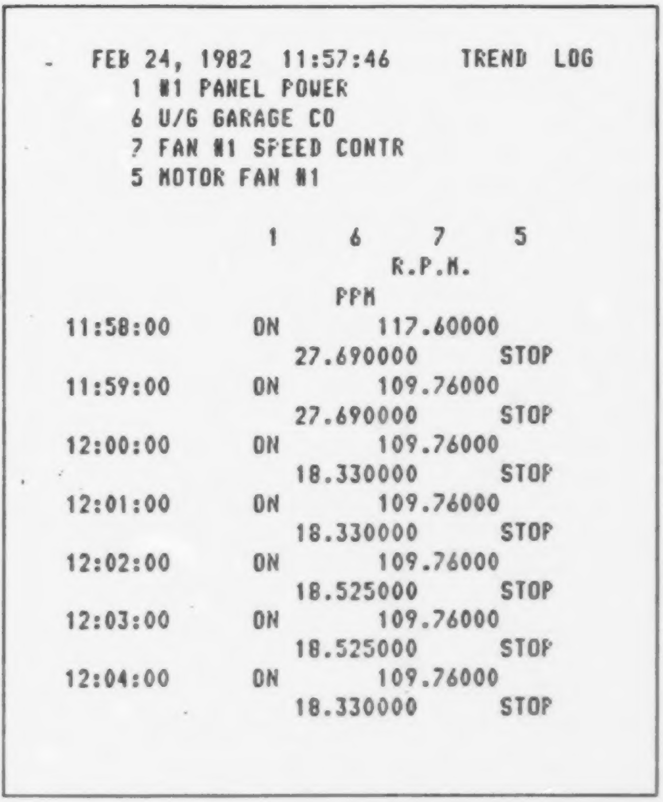
A shift report printout is shown in figure C-6. Shift report times of generation are set by the user with the TSR command. Up to 30 analog points may be entered for the shift report with the SPN command. Average readings from the previous interval are printed at the desired times.

A sequence programming unit printout is shown in figure C-7. This printout shows the sequence header containing SPU number, priority, and hold status, followed by three events and link pointer. Command delays and test decisions are also shown. This printout is generated for a desired range of SPUs by the PSQ command.

An example of a sequence trigger printout is shown in figure C-8. Point numbers and descriptors are printed with their trigger condition and SPU starting number. This printout is generated with the STP command.

Figure C-9 is an example of an alarm summary printout. This example shows the different types of alarms possible with this system. This printout is generated by depressing the ALARM SUMMARY special key.

Figure C-10 is an example of an all points log. This log when requested will display the status of all the points in the system at the requested time. This report is activated by the ALP command.



```
-  FEB 24, 1982  11:57:46     TREND  LOG
      1 #1 PANEL POWER
      6 U/G GARAGE CO
      7 FAN #1 SPEED CONTR
      5 MOTOR FAN #1

                 1     6     7     5
                             R.P.M.
                       PPM
11:58:00      ON       117.60000
                 27.690000      STOP
11:59:00      ON       109.76000
                 27.690000      STOP
12:00:00      ON       109.76000
                 18.330000      STOP
12:01:00      ON       109.76000
                 18.330000      STOP
12:02:00      ON       109.76000
                 18.525000      STOP
12:03:00      ON       109.76000
                 18.525000      STOP
12:04:00      ON       109.76000
                 18.330000      STOP
```

FIGURE C-1

```
FEB 24, 1982  11:49:20   ACCESSOR  LIST

ADDRESS  TRUNK1   TRUNK2   TRUNK3   TRUNK4
   000       ---   *    1      ---      ---
   001       ---   *    5      ---      ---
   002       ---      ---      ---      ---
   003       ---      ---      ---      ---
   004       ---   *    8      ---      ---
   005       ---   *    6      ---      ---
   006       ---      ---      ---      ---
   007       ---      ---      ---      ---
   008       ---   *   19      ---      ---
   009       ---      ---      ---      ---
   010       ---      ---      ---      ---
   011       ---      ---      ---      ---
   012       ---      ---      ---      ---
```

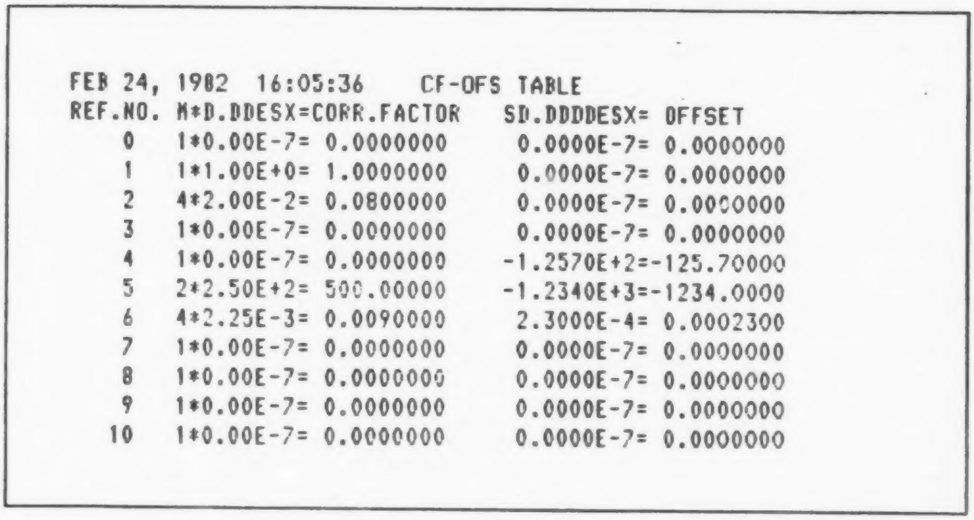
FIGURE C-2

```
FEB 24, 1982  11:48:01   DESCRIPTOR LIST
  NO.  DESCRIPTOR         R P D G H TYP M3/UN M2 TR ADDR
    1 #1 PANEL POWER      A 3 3 0 Y  6     NO 03  2  000
    2 FINE ORE CONVEYOR   A 3 3 0 Y  6     NO 05  X  XXX
    3 U/G SUMP LEVEL      A 3 3 0 Y  6     NO 01  X  XXX
    4 EXHAUST AIR FAN #1  A 3 3 0 Y  6     NO 05  X  XXX
    5 MOTOR FAN #1        A 3 3 0 Y  4     00 07  2  001
    6 U/G GARAGE CO       A 3 3 0 Y  0     13 01  2  005
    7 FAN #1 SPEED CONTR  A 3 3 0 Y  2     16 01  2  032
    8 U/G CO ALERT        A 3 3 0 Y  7     00 03  2  004
    9 U/G CO EMERGENCY    A 3 3 0 Y  7     01 03  X  XXX
   10 FAN #1 FAIL         A 3 3 0 Y  7     02 03  X  XXX
   11 POWER FAILED        A 3 3 0 Y  7     03 03  X  XXX
   12 SYSTEM STATUS       A 3 3 0 Y  7     04 08  X  XXX
   19 EXHAUST AIR FLOW    A 3 3 0 Y  0     11 01  2  008
  100 MOTOR STARTER L.23  A 3 3 2 Y  4     00 03  3  055
  512 DATA-LINK ERROR ..  A 3 3 0 Y  0     00 01  X  XXX
```

FIGURE C-3

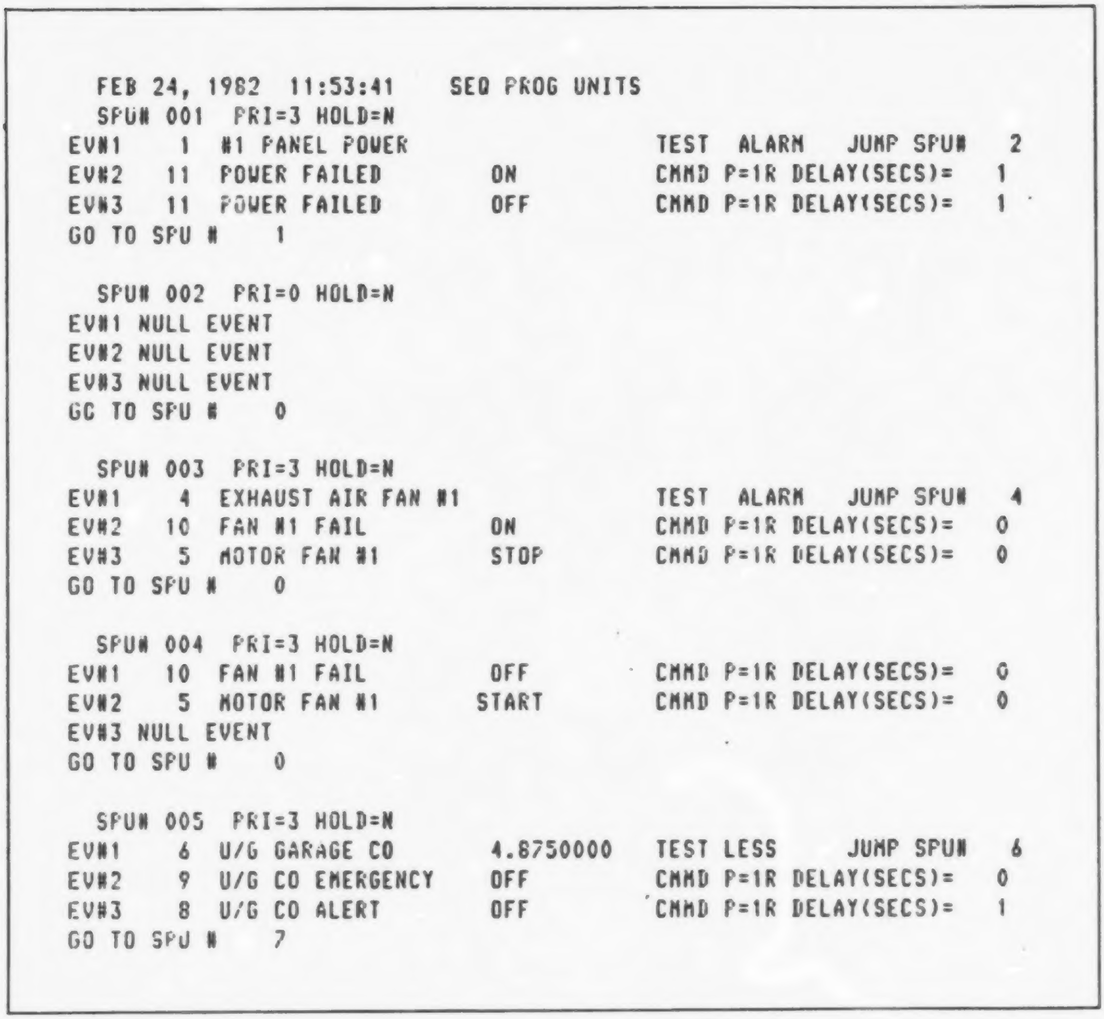
```
 FEB 24, 1982  11:48:45      ANALOG DATA
 NO.  DESCRIPTOR          OFS  CF      HIGH              LOW          UNITS     DELAY         RANGE
   6 U/G GARAGE CO          0    0 255= 49.725000    0= 0.0000000   13=  PPM       2    0.0000000 * 49.725000
   7 FAN #1 SPEED CONTR     1    1  27= 105.84000   26= 101.92000   16= R.P.M.     2    0.0000000 * 999.60000
  19 EXHAUST AIR FLOW       2    2 255= 3009.0000    0= 0.0000000   11= F.P.M.     2    0.0000000 * 3009.0000
 512 DATA-LINK ERROR ..     3   10  10= 0.0000000   10= 0.0000000    0=           40    0.0000000 * 0.0000000
```

FIGURE C-4



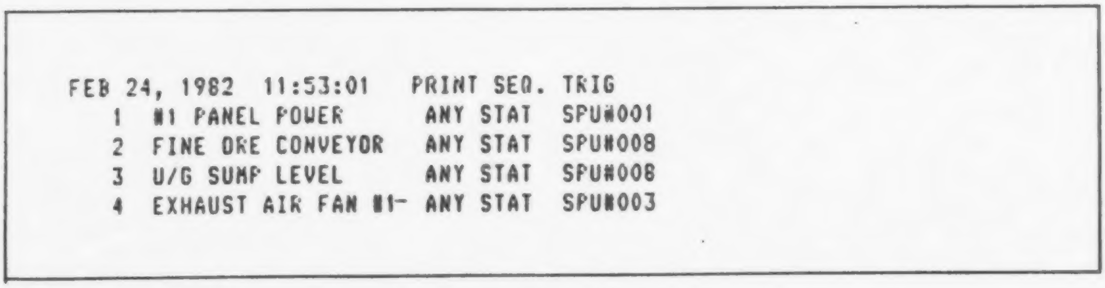
```
FEB 24, 1982  16:05:36    CF-OFS TABLE
REF.NO. M*D.DDESX=CORR.FACTOR   SD.DDDDESX= OFFSET
    0    1*0.00E-7= 0.0000000    0.0000E-7= 0.0000000
    1    1*1.00E+0= 1.0000000    0.0000E-7= 0.0000000
    2    4*2.00E-2= 0.0800000    0.0000E-7= 0.0000000
    3    1*0.00E-7= 0.0000000    0.0000E-7= 0.0000000
    4    1*0.00E-7= 0.0000000   -1.2570E+2=-125.70000
    5    2*2.50E+2= 500.00000   -1.2340E+3=-1234.0000
    6    4*2.25E-3= 0.0090000    2.3000E-4= 0.0002300
    7    1*0.00E-7= 0.0000000    0.0000E-7= 0.0000000
    8    1*0.00E-7= 0.0000000    0.0000E-7= 0.0000000
    9    1*0.00E-7= 0.0000000    0.0000E-7= 0.0000000
   10    1*0.00E-7= 0.0000000    0.0000E-7= 0.0000000
```

FIGURE C-5



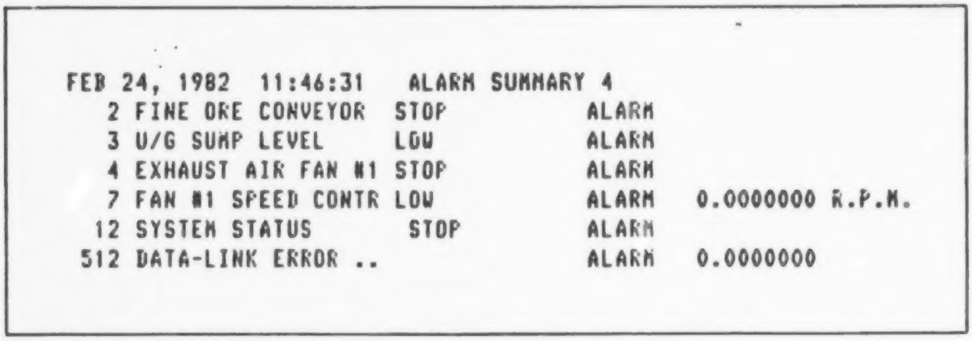
```
  FEB 24, 1982  11:53:41    SEQ PROG UNITS
  SPU# 001  PRI=3 HOLD=N
EV#1     1  #1 PANEL POWER                      TEST  ALARM   JUMP SPU#   2
EV#2    11  POWER FAILED        ON              CMMD P=1R DELAY(SECS)=   1
EV#3    11  POWER FAILED        OFF             CMMD P=1R DELAY(SECS)=   1
GO TO SPU #    1

  SPU# 002  PRI=0 HOLD=N
EV#1 NULL EVENT
EV#2 NULL EVENT
EV#3 NULL EVENT
GC TO SPU #    0

  SPU# 003  PRI=3 HOLD=N
EV#1     4  EXHAUST AIR FAN #1                  TEST  ALARM   JUMP SPU#   4
EV#2    10  FAN #1 FAIL         ON              CMMD P=1R DELAY(SECS)=   0
EV#3     5  MOTOR FAN #1        STOP            CMMD P=1R DELAY(SECS)=   0
GO TO SPU #    0

  SPU# 004  PRI=3 HOLD=N
EV#1    10  FAN #1 FAIL         OFF             CMMD P=1R DELAY(SECS)=   0
EV#2     5  MOTOR FAN #1       START            CMMD P=1R DELAY(SECS)=   0
EV#3 NULL EVENT
GO TO SPU #    0

  SPU# 005  PRI=3 HOLD=N
EV#1     6  U/G GARAGE CO       4.8750000       TEST LESS     JUMP SPU#   6
EV#2     9  U/G CO EMERGENCY    OFF             CMMD P=1R DELAY(SECS)=   0
EV#3     8  U/G CO ALERT        OFF             CMMD P=1R DELAY(SECS)=   1
GO TO SPU #    7
```

FIGURE C-7



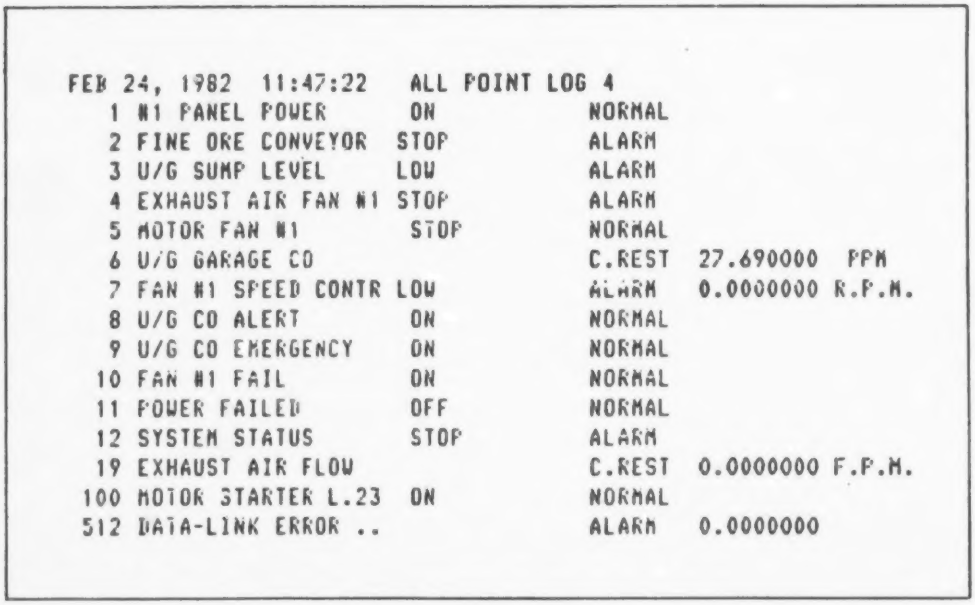
```
FEB 24, 1982  11:53:01   PRINT SEQ. TRIG
   1  #1 PANEL POWER       ANY STAT  SPU#001
   2  FINE ORE CONVEYOR    ANY STAT  SPU#008
   3  U/G SUMP LEVEL       ANY STAT  SPU#008
   4  EXHAUST AIR FAN #1-  ANY STAT  SPU#003
```

FIGURE C-8



```
FEB 24, 1982  11:46:31   ALARM SUMMARY 4
   2 FINE ORE CONVEYOR  STOP          ALARM
   3 U/G SUMP LEVEL     LOW           ALARM
   4 EXHAUST AIR FAN #1 STOP          ALARM
   7 FAN #1 SPEED CONTR LOW           ALARM   0.0000000 R.P.M.
  12 SYSTEM STATUS       STOP         ALARM
 512 DATA-LINK ERROR ..               ALARM   0.0000000
```

FIGURE C-9



```
FEB 24, 1982  11:47:22   ALL POINT LOG 4
   1 #1 PANEL POWER      ON           NORMAL
   2 FINE ORE CONVEYOR  STOP          ALARM
   3 U/G SUMP LEVEL     LOW           ALARM
   4 EXHAUST AIR FAN #1 STOP          ALARM
   5 MOTOR FAN #1        STOP         NORMAL
   6 U/G GARAGE CO                    C.REST  27.690000  PPM
   7 FAN #1 SPEED CONTR LOW           ALARM   0.0000000 R.P.M.
   8 U/G CO ALERT        ON           NORMAL
   9 U/G CO EMERGENCY    ON           NORMAL
  10 FAN #1 FAIL         ON           NORMAL
  11 POWER FAILED        OFF          NORMAL
  12 SYSTEM STATUS       STOP         ALARM
  19 EXHAUST AIR FLOW                 C.REST  0.0000000 F.P.M.
 100 MOTOR STARTER L.23  ON           NORMAL
 512 DATA-LINK ERROR ..               ALARM   0.0000000
```

FIGURE C-10

APPENDIX D

SYSTEM COMMANDS SORTED BY FUNCTION

APPENDIX D - SYSTEM COMMANDS SORTED BY FUNCTIONS

Print Routines	Command	
Trend Log	LTT, TREND HDG	Used to enter data consisting of time period and point assignment for trend log generation. Up to 10 analog points are permitted, and time period is variable from 1 to 99 min. The TREND HDG special key will produce a heading for the printout.
Accessor scan list	ACC	Produces printout of accessor scan list sorted by address and trunk number. This indicates which addresses are enabled in the scan .
Descriptor list	DSS	Prints out point numbers, addresses, and descriptors as well as other information, including announcement (printer/horn/display enablement), accessor type, units code or contacts type, mode code, and trunk number. This command may be used to verify operator inputs entered with the NEW command.
Shift report	TSR (S), SPN (S), REQ	Generates printouts every hour or up to five times per 24-hr period of the averaged values per point for up to 30 points. The TSR command is used to set shift report times from 00:00 to 23:00 (military time). The SPN command assigns points for the printout. The REQ command may be used any time to request the current shift report without resetting the count or average.
Correction factor and offset table	PCO (S)	Prints desired range of correction factors and offsets in both machine and floating-point decimal format. This command may be used to verify proper entry of correction factors and offsets (through CFI and OFS commands).
Analog Parameter list	PAP	Prints analog parameters such as CF, OFS, high limit, low limit units code and delay to alarm for each analog point.

APPENDIX D - SYSTEM COMMANDS SORTED BY FUNCTIONS Continued

Sequence programming units	PSQ (S)	Prints desired range of sequence programming units. This includes sequence number, priority, hold status, events, and link pointer. This may be used to keep a record of SPU's or to verify sequence data entry.
Sequence triggers	STP (S)	Prints all sequence triggers in the system or point number. This includes descriptor, trigger conditions, and SPU number.
Print Command Priority	PCR	Print current command priorities.
Alarm summary	ALARM SUMMARY	Prints all current alarms by point number and identifies alarm conditions.
Time/Date	TIME/DATE	Prints current time and date.
Free Line Printer	FLP	Aborts printout of any current user selected log. (It does not disable event or alarm printouts).

Refer to Appendix C for example printouts of the above routines.

Commandable Points	Command	
Binary point (B2, B25 Accessors)	COC, COMM BINARY (K)	Used to execute a mode 1, 2, 3, or 4 command on a binary point. Depending on the result, a COMMAND EXECUTED or a COMMAND FAILED will be printed.
Analog point C5, etc)	CPA, COMM ANALOG (K)	Used to change the output value of a commandable analog point. A CRT/printer message will indicate command result.

Status File Editing	Command	
Descriptor entry/ change	DSE	Allows descriptor change of any point. New descriptor must contain 18 characters (blanks are permitted).

APPENDIX D - SYSTEM COMMANDS SORTED BY FUNCTION Continued

Analog Parameter change	CAP	May be used to change alarm limits, correction factor and offset references, units code, and other parameters for analog points.
Correction factor entry/change	CFI	Enters correction factors into reference table. Only properly formatted correction factors are accepted.
Offset entry/ change	OFS	Enters offsets into reference table. Only properly formatted offsets are accepted.
New accessor data entry	NEW (S)	Enters new accessor data into memory.
Edit the scan	EDS (S)	Enables or disables accessors from the scan.
Delete a data point	KIL (S)	Removes a specific point from memory. This would be used before entering new accessor data into an old point number of different accessor type.
Change access codes	EAC (S)	May be used to change access codes in case of broken security.
CRT display editing		
Auto screen roll/ acknowledge	ROL	Automatically acknowledges and deletes old events from CRT alarm area when all 12 lines have been filled to allow for display of new alarms.
Set time and date	STT, STD	Used to enter correct time and date in numerical format. A printout is generated automatically after a new date is entered.

Immediate status request	ISR, STATUS (K)	Displays immediate status of any point in system at the time command is issued. This display is not updated.
Clear CRT screen	CRT	Clears CRT screen. Stale information will become invisible; only updated information will appear.
Continuous status monitoring	CS1- CS6	Enters desired point into the continuous status area on lower part of CRT. Also used to delete points from this area.
Disk status		
Save status on disk	SVD (S)	Saves current RAM status on disk.
Read status from disk	RDS (S)	Loads status from disk into memory.
Format a disk	FMT (S)	Formats a new disk so it will be system-compatible.

APPENDIX E

SUBMITTAL DOCUMENTS TO CANMET

conspec

44 martin ross avenue, downsview, ontario M3J 2K8
telephone (416) 661-0500
telex 06-966710

April 26, 1982

J.A. Bossert
Certification Officer
Building No. 9
CANMET Bells Corners Complex
Haanel Drive
Ottawa, Ontario

Dear Mr. Bossert:

Re: Submittal for Intrinsic Safety Approval

Please find enclosed the following:-

(a) System Description
(b) Drawing List and Drawings
(c) Description of Drawings.

Our company would like to obtain approval for use of our Senturion 200 monitoring system in coal mines.

The enclosed information is related to the field hardware, and the processor interfaces. Information pertaining to the power-supply, packaging and Analog input field devices are currently being revised and will be made available to you by mid-May.

Should you require any further information, please do not hesitate to contact me.

Yours faithfully,

M.H. Mohamed

MHM/jc

cc: R. Chakravorty

conspec

44 martin ross avenue, downsview, ontario M3J 2K8
telephone (416) 661-0500
telex 06-966710

July 16, 1982

Mr. G. Lobay
Certification Officer
Building No. 9
CANMET Bells Corners Complex
Haanel Drive
Ottawa, Ontario

Dear George:

Please find enclosed a set of drawings for the intrinsically safe trunk driver unit for use on our Senturion 200 system. This unit is to be located underground, in a coal mine in a designated safe area. The unit requires 120V AC for operation and has a battery pack capable of providing up to 10 hours (minimum) of standby power.

The unit is connected to the surface computer via a telephone line (one pair). It also generates 15 volts IS power for use on an external trunk which will be wired into hazardous areas.

Should you require any further information, please do not hesistate to contact me.

Yours faithfully,

M.H. Mohamed

MHM:jc
Encl.

c.c.: John Bossert
R. Chakravorty

DC Power Supply

Schematic: 10180 Artwork: A 1052
Assy: 10183 Silkscreen: A1053

IS Power Supply

Schematic: 10174 Artwork: A1044
Assy: 10178 Silkscreen: A1045
Solder Mask: A1046

Trunk Driver

Schematic: 10134 Artwork: A1042
Silkscreen: A1043

Modem Interface Card

Schematic: 10067
Assy: 10070

Remote Trunk Driver

Enclosure: 10195
Chassis: 10194 Sht 2
Door & Bracket: 10194 Sht 1

Internal Assy: 10197
Internal Wiring: 10196

conspec

44 martin ross avenue, downsview, ontario M3J 2K8
telephone (416) 661-0500
telex 06-966710

September 23rd, 1982.

Certification Officer
Building No. 9
CANMET Bells Corner Complex
Haanel Drive
Ottawa, Ontario

Attention: George Lobay

Reference: Intrinsically Safe Approvals

Dear Sir:

Please find enclosed a set of drawings relating to our analog input devices, as well as the schematic diagrams of three of the instruments we intend using on the system. The accompanying sheet provides a drawing list as well as a brief description of the contents.

Should you require any further information, please do not hesitate to contact me.

Yours very truly,

M.H. Mohamed

cc: J. Bossert
R. Chakravorty

Drawing List

A. Analog Input Accessors

These are the devices used to interface to analog signals from instruments for which approval will be required, to the Senturion 200 System.

One analog device exists for each of the standard analog input ranges and is identified by a unique model number in the range A49-A69.

A49 - This device is a standard analog with A/D converter, but no provision for any inputs. It is only used for identifying the boards during production.

The table on the following sheet describes the input parameters for each of the analog devices.

Drawings enclosed are:

10175 Rev. B Schematic of Basic Analogs for A49-A61.

A1040 Rev 0 - Artwork for Basic Analog devices.

A1041 Rev 0 Silkscreen for Basic Analog devices.

10187 Rev 0 - A50 Analog Accessor Assembly.
10188 Rev 0 - A51 Analog Accessor Assembly.
10189 Rev 0 - A52 Analog Accessor Assembly.
10190 Rev 0 - A53 Analog Accessor Assembly.
10186 Rev 0 - A54 Analog Accessor Assembly.
10176 Rev 0 - A55 Analog Accessor Assembly.
10177 Rev 0 - A56 Analog Accessor Assembly.
10181 Rev 0 - A57 Analog Accessor Assembly.
10185 Rev 0 - A58 Analog Accessor Assembly.
10182 Rev 0 - A59 Analog Accessor Assembly.
10222 Rev 0 - A60 Analog Accessor Assembly.
10226 Rev 0 - A61 Analog Accessor Assembly.

10223 Rev 0 - Schematic for the A63, A64, A67, RTD input Accessors.

10224 Rev 0 - Assembly for A63, A64, A67 Accessors.

B. Telephone Line Barrier

This device is used to protect the modems and the telephone link.

10215 Rev 0 - Telco line Barrier Schematic Assembly.

A1057 Rev 0 - Telco line Barrier Artwork.

C. Instruments

1. J-Tec Airflow Unit Models VA:215 and VA216B

   Schematic Dwg. No. DDC0338 Rev B
   Interface Wiring Dwg. No. 10227 Rev 0

2. J-Tec Methanometer Model VM101B

   Schematic Dwg. No. DDC0339 Rev A
   Interface Wiring Dwg. No. 10228 Rev 0

3. Energetic Science CO-Diffusion Monitor: Model 5001

   Schematic 1008-050 Rev B
   Mechanical 1008-911 Rev XB
   Interface Wiring 1229 Rev 0

D. General Drawings

1. Splitter Box. This is used for making splices in the trunk cable, and for making taps into the trunk in order to add instruments or accessors.

   Dwg. No. 10231 Rev 0

2. Modems are used to handle the data over telephone lines from the surface.

   Modem Specification:- 10211 Rev 0

MODEL NO.	PART NO.	ANALOG INPUT	INPUT IMPEDANCE (OHMS)	NO. OF ADJUSTMENTS
A49	P1153	None	--	--
A50	P1154	0 - 1 Volt or 0 - 1 mA	1,000	1
A51	P1155	0 - 10 Volts	10,000	1
A52	P1156	0 - 5 mA	200	1
A53	P1157	0 - 20 mA	50	1
A54	P1158	1 - 5 Volts	50,000	2
A55	P1151	0 - 5 Volts	5,000	1
A56	P1159	4 - 20 mA	50	2
A57	P1160	1 - 5 mA	200	2
A58	P1161	0.2 - 1.0 Volts	1,000	2
A59	P1162	1 - 0 Volt or 1 - 0 mA	1,000	3
A60	P1197	0-1V DIFF.	100,000	1
A61	P1202	0.5V-1.5 Volts	2,000	2

conspec

44 martin ross avenue, downsview, ontario M3J 2K8
telephone (416) 661-0500
telex 06-966710

November 8th, 1982.

Mr. G. Lobay.
Certification Officer,
Building No. 9,
CANMET Bells Corners Complex,
Haanel Drive,
Ottawa, Ontario.

Reference: Your Ref: C015-C55-1
Part No. 4.3.0.2.02.01

Dear Mr. Lobay,

Please find enclosed copies of the drawings which were revised to show the inclusion of a switch and terminal block for the battery. The purpose of the switch is to shut off battery power when shipping and installing the system.

The system will be available in Ottawa on the 22nd, November, 1982, for your inspection of these changes. Also enclosed, for your information, is a copy of the installation and maintenance manual for the remote trunk driver box.

Should you require any further information please do not hesitate to contact me.

Yours truly,

M.H. Mohamed

MHM/ydr.
Encl:

Enclosure

Items:	Dwg #	Rev #	Description
1.	10194 (sheet 2)	D	Main Chassis Detail
2.	10196	B	Trunk Driver Wiring
3.	10197	B	Trunk Driver Assembly
4.	R1047	0	Remove I/S Trunk Driver Installation and Maintenance Manual.

conspec

44 martin ross avenue, downsview, ontario M3J 2K8
telephone (416) 661-0500
telex 06-966710

December 6th, 1982.

Mr. G. Lobay
Certification Officer, Bldg #9,
CANMET, Bells Corners Complex,
Haanel Drive, Ottawa,
Ontario.

Dear Sir,

Please find enclosed a copy of the specification for our Accessor trunk cable. The cable manufacturer is Mercury Wire, and their assigned part no is P/N #2389. Our company assigned part no is P1209.

Should you require any further information please do not hesitate to contact me.

Yours truly,

M.H. Mohamed
Encl:

APPENDIX F

DESCRIPTION OF CONSPEC I/S POWER SUPPLY P1166

Description of I.S. Power Barrier - Part No. P1166

The intrinsically safe I.S. power barrier is designed to provide a 15 Volt nominal output at current levels up to approximately 500 mA. The input voltage is set at 27.6 volts. The safety of the power source is assured by the use of triple redundant voltage regultor, each of which are preceded by current limiting wire-wound resistors. In addition, the input and output is protected by 50 Watt zener diodes (D1 and D2). The input to the first stage is limited to a maximum of 27 volts, and the output to a maximum of 16 Volts. The system has been set up such that a failure of any two components would still maintain an intrinsically safe output. Worst case output condition is with U3 shorted, and D2 open circuit.

Additionally the input is fused at 1 amp for protection against short circuit failures of either the input or output zeners. The voltage regulators used are the LM117K which are manufactured by National Semiconductors, and have adjustable outputs. The voltage to which each voltage regulator stage is set at, is as follows:-

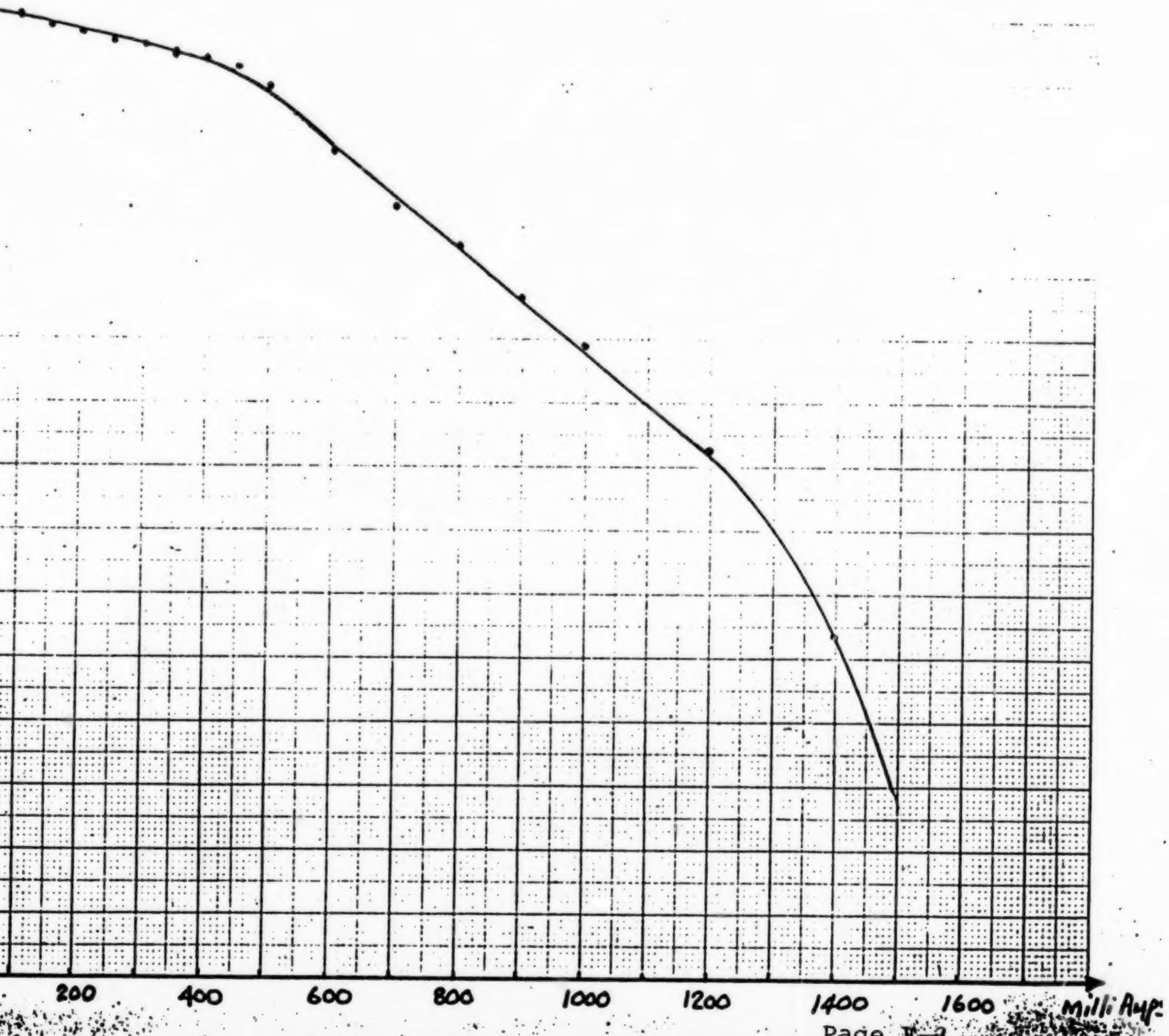
Stage 1 = 21 Volts (output of U1)
Stage 2 = 18 Volts (output of U2)
Stage 3 = 15 Volts (Output of U3)

Note, these devices also contain internal circuitry which would limit the current through them to 1.5 Amps. A plot showing the output voltage and current characteristics is given on the following page.

Due to the large amount of current limiting resistors used, the output characteristic of the barrier is highly resistive.

JUNE, 1982

VOLTAGE VS CURRENT CHARACTERISTIC
FOR I.S. POWER SOURCE.
CONSPEC PART NO. P1166.



APPENDIX G

TESTING AND REVIEW CORRESPONDENCE WITH CANMET

MAY 31 1982

Energy, Mines and Resources Canada
Énergie, Mines et Ressources Canada

Science and Technology Science et Technologie
Telephone: 613-996-4570 ext. 128
Telex : 053-3586

Your file Votre référence

May 26, 1982.

Our file Notre référence C015-C55-1
Pr. No. 4.3.0.2.02.01

Conspec Controls,
44 Martin Ross Ave.,
Downsview, Ontario.
M3J 2K8

Attention: Mr. Mohammed

Dear Sir:

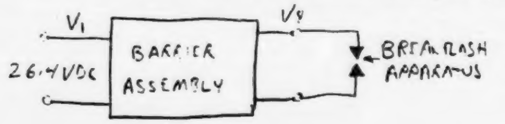
Subject: Intrinsically Safe Power Supply

With reference to our meeting of May 21, 1982 and Intrinsically Safe testing as related to coal mining applications, this is to confirm the results obtained therefrom.

All tests were performed using Conspec drawing 10174 as a reference and a prototype power supply unit for tests. The test gas was 8.3% methane in air, and the methods and apparatus used were as specified in CSA Standard C22.2 No. 157-M1979 "Intrinsically Safe and Non-Incendive Equipment for Use in Hazardous Locations". For the purposes of testing, the fuse (F1) was replaced with a fuse having a 5A rating rather than the normal 1A rating. Before and during testing, the sensitivity of the test apparatus and the gas mixture was evaluated by means of a calibration circuit consisting of a 24 volt D.C. power supply, a resistance substitution box, an ammeter, a 95 millihenry air core inductor and the breakflash apparatus all in series. The calibration current was set at 110 mA. The apparatus was proven to be sufficiently sensitive before and after each test by means of ignitions obtained using the foregoing calibration circuit.

Test 1

Input voltage was 26.4 VDC, and all components were operating normally with the following test arrangement:



This test arrangement caused no ignition.

.../2

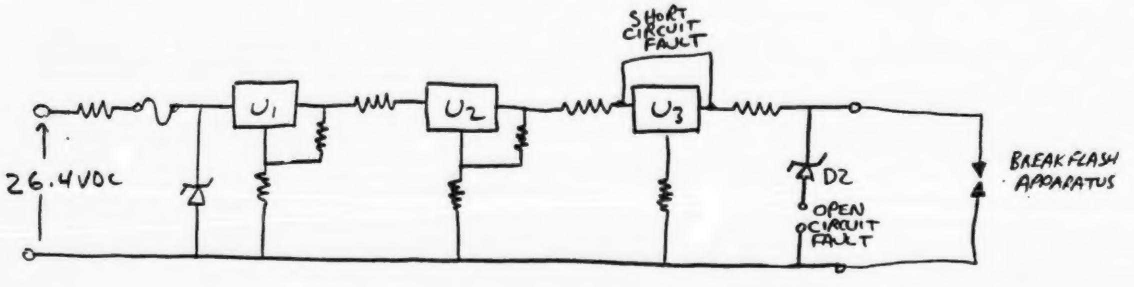
Canada Centre for Mineral and Energy Technology,
555 Booth Street,
Ottawa, Canada.
K1A 0G1

Centre canadien de la technologie des minéraux et de l'énergie,
555, rue Booth,
Ottawa, Canada,
K1A 0G1

Canada

Test 2

Input voltage was 26.4 VDC, and all components were operating normally except D2 was an open circuit, and U3 was a short circuit.

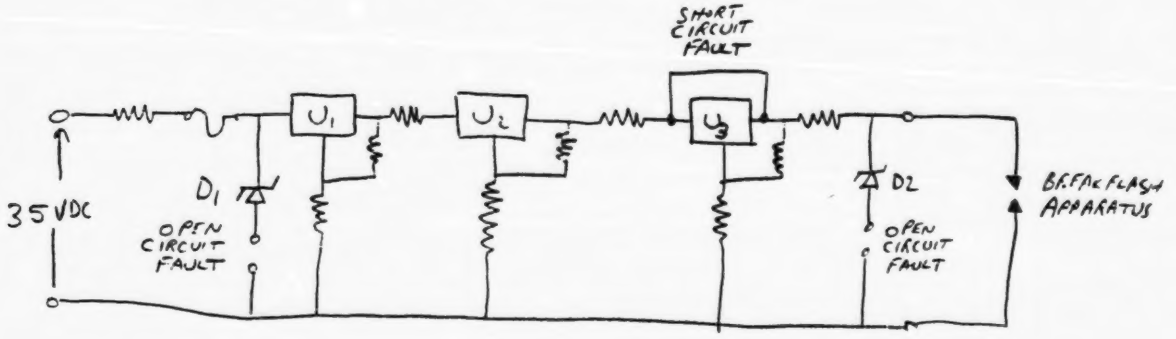

SHORT CIRCUIT FAULT
U1
U2
U3
26.4VDC
D2
OPEN CIRCUIT FAULT
BREAK FLASH APPARATUS

REF. DWG. 10174

This test arrangement caused no ignition.

Test 3

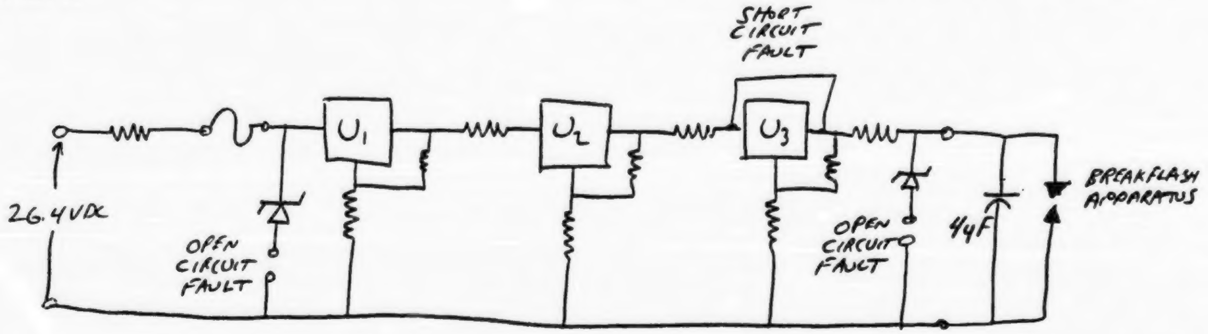
Input voltage was 35 VDC, all components were operating normally except D1 and D2 were open circuits, and U3 was a short circuit.


SHORT CIRCUIT FAULT
U1
U2
U3
35VDC
D1
OPEN CIRCUIT FAULT
D2
OPEN CIRCUIT FAULT
BREAK FLASH APPARATUS

This test arrangement cuased no ignition.

Test 4

Input voltage was 26.4 VDC, all components were operating normally except D1 and D2 were open circuits, and U3 was a short circuit. In addition 4 microfarads of non-polarized capacitance were connected across the I.S. output terminals of the barrier.



This test arrangement caused no ignition.

The above indicates that insofar as circuit design is concerned, the apparatus meets our requirements for certification for use in underground coal mines as a power supply with an Intrinsically Safe output. However, we cannot issue a certificate until a visual examination is made of a final production prototype of this device. We will therefore wait until given further notice regarding an inspection of this unit.

Enclosed, for your information, is a copy of the tests which pertain to communication cables.

Yours truly,

G. Lobay, P. Eng.,
Investigating Officer, Electrical
and Diesel Flameproof,
Canadian Explosive Atmospheres Laboratory.

GL/mmi
encl.

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Resources Canada

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Énergie, Mines et
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Your file Votre référence

Our file Notre référence
C015-C55-1
Pr. No. 4.3.0.2.02.01

September 17, 1982.

SEP 24 1982

SEP [illegible] 1982

CONSPEC,
44 Martin Ross Ave.,
Downsview, Ontario.
M3J 2K8

Attention: Mr. M.H. Mohamed

Dear Sir:

Subject: Intrinsic Safety of Senturion 200 System

The following is our commentary regarding the Intrinsic Safety aspects of the CONSPEC Senturian 200 System. This commentary also serves as my review summary of the operation of the system as well, so several of the items below do not require any action on your part - they are for my review purposes. If I am wrong in some of my comments, please let me know.

10110, 10109, 10111 - System Configurations

We do not have any objection to the system configurations, but we do wish to note the following:

1) The note "Flameproof enclosure must be located in a designated safe area" does not seem quite appropriate as, if an enclosure is flameproof, its construction allows it to be located in a hazardous area. Usually, only if an enclosure is housed in a non-flameproof enclosure must it be located in a non-hazardous area.

2) It is suggested that on the drawings for system configurations, that the boundary between the hazardous and non-hazardous areas be clearly indicated by a dashed line.

3) It should be noted that it may not be possible to have a "designated safe" area anywhere underground in

Canada

many coal mines, and it may be a local (Provincial) regulation that all electrical apparatus underground be suitable for use in hazardous locations. The point is that, before using the configuration which assumes safe areas underground, it would be wise to talk to the local authorities and customers.

10024 - Octal - Serial Convertor

This conversion occurs upstream of any I.S. conditioning and is always located in a safe area.

10134 - Accessor Trunk Driver

No explanation is given regarding the Accessor Checker Input and the questions are as follows:

1) Is P2 considered to be an I.S. connector? If so, it must be isolated in the usual manner (adequate spacing) from the non-I.S. portions of the circuit.

2) Is it correct to assume that the +20 V supply indicated at P2 is derived from the output of R46, therefore making it an I.S. supply?

3) What will be the use of the Accessor checker input? Have precautions been taken to indicate that, if used, it will be treated as an I.S. circuit? Also, what will be connected to the Accessor checker input?

4) What is the maximum isolation voltage or breakdown voltage of U1 and U4? A manufacturer's specification sheet would be ideal for these opto - isolators.

5) With reference to section 4.3.9 of C22.2 No. 157, Spacings, in order to be considered not subject to breakdown, minimum spacing requirements on the circuit board must be met. Since the peak voltage is under 60 V (Table 1) the separation between I.S. and non I.S. components must be 3 mm or more. This can be reduced on the PCB to 1 mm if a suitable adherent insulating coating is used on the board. Please advise us as to what the spacings are in this regard and what portions of the circuit have been examined for spacing compliance.

6) Suitable identification and separation of I.S. and non-I.S. terminals must be made. (To be verified on visual inspection.

page........2

7) Please note that an updated schematic for the accessor trunk driver arrived after the original submission, and it was accompanied by a very good double-sided PC board layout drawing so that spacings could, in fact, be checked. It appears that the closest over-board distance that IS/non IS circuits have is 5 mm. If a suitable insulating adherent coating were used, then this spacing would be adequate for forseeable faults occurring on the system. Please verify that in addition to the application stated in your letter of July 16, 1982 (underground applications) that the same board is used above ground for system layouts of the "configuration one" type.

529-342 LD Accessor

This device extends the accessor trunk over two pairs of telephone lines (non I.S. telephone lines). One is required at each end of the telephone lines.

1) Suitable identification and separation of I.S. and non I.S. terminals to be made. (To be verified on visual inspection).

2) All the comments regarding spacing for drawing 10134 - paragraph (5) also apply to this sheet. Please note that we are asking you to check out the spacings because the artwork on sheets 1 and 2 of dwg. no. 529-341 is difficult to relate to dwg. no. 529-340 R4. We would not want any of the spacings to be considered subject to fault, so with a suitable insulating adherent coating applied, if as general design constraint spacings were 1 mm or more, no spacing analysis of the board would be necessary, and the "not subject to fault" rule would prevail. I hope this is the case.

3) Again, we would like to get the maximum isolation voltage or breakdown voltage of the opto - isolators.

10066 - Driver/Receiver Module

This unit is used in all accessors and is the interface between the accessor and the accessor trunk. It is an interface between an I.S. circuit (trunk lines) and an I.S. circuit assembly (accessor).

1) There is no problem with the additive effect of many of these units on the trunk insofar as C2 is concerned, because for each C2, there is an R15 on the accessor to provide effective isolation, in addition to the input rectifier.

page........3

2) This device provides regulated output (10VDC) to its accessor.

527-673 - B1 Accessor

This device monitors contacts and their status. The circuitry on this board must be looked at in conjunction with the receive-drive module.

It is assumed that J2 is the point at which connections are made to monitor the status of contacts. As this is an input port, we have no control over what sort of devices are connected to the accessor. If a passive device were connected to this port, and suitable identification and cautions in accordance with the applicable electrical installation code requirements were made that the device was connected to an I.S. system, we would have no objection to this sort of implementation. An example would be connection to a bin level switch, float switch, air flow switch, etc. Such devices would employ no electrical connection other than the above accessor connection, and have no local power supply whatever.

There are applications which the accessor has, however, which are not appropriate to the I.S. considerations. For example, the accessor can monitor the status of a motor starter through an auxiliary contact on the starter. In an I.S. system, even though these contacts were not electrically connected to the main power terminals supplying the motor, the contacts (as part of the starter) would have to be separately approved as being suitable for connection to I.S. systems. The consideration would be spacing and segregation of the auxiliary contacts, and identification as being I.S. contacts in the starter to preclude accidental connection to high energy sources. It is not sufficient to allow connection of the accessor to auxiliary contacts in devices such as this unless the contacts of the device have been approved for such installations.

If a high energy source was inadvertently connected to J2 of the accessor, these high energies would appear on the I.S. lines with only one fault in the receive-drive module. The current paths would be in pin 3 of J2, to A4 pin 8, to pin 3 of A4 (with no fault because the microcircuit spacing is so small) to pin 2 of the receive/drive module and into the intrinsically safe trunk power line. D1 of the receive/drive module would not have to fail because it could conduct on negative half cycles.

All this serves to ask the question - how is the B1 accessor proposed to be used in I.S. systems?

529-023-R3 B2 Accessor

This an output control device. Connection could only be made to devices approved as intrinsically safe.

10144 Simplified Schematic of Trunk/Accessor Electrical Interface

Trunk driver uses optical coupling.

200 - 308 B25 Accessor Schematic

Connection would be restricted to I.S systems only.

10197 - Internal Assembly Drawing - Remote Trunk Driver

Suitable precautions must be made to keep I.S. wiring isolated from non-I.S. wiring. An inspection must be made of this component.

529 - 497 B20 & B28 Accessor and Termination Board

This device is an expansion of the single contact input device. Only connection to contacts in passive devices such as tilt switches, float switches,and air flow switches would be permitted unless the monitored device had output contacts suitable for connection to I.S. circuits and was approved as such. The reason is that, if contact sets not approved for connection to I.S. systems were connected, undefined levels of fault voltage could appear at TB2 of sheet 529-497. The spacings on the PCB are not sufficiently great to be considered as not subject to fault in the presence of fault voltages typically encountered in the field. For example, if the electrician inadvertently connects 110 VAC to TB2, the spacings are insufficient to resist this voltage level within the context of Spec. 157. As a specific example, the spacing between pin 1 and 5 on A25 of the foil on the PCB is about 1 mm. With a suitable adherent insulating coating applied to the board, the allowable peak voltage at pin 1 would be only 60 volts. This is only one small part of the circuit board that does not satisfy spacing requirements of segregation between I.S. and non-I.S. circuits.

We need a clarification as to what type of input devices this accessor is expected to monitor. Also, what is the difference between a B20 and B28 accessor?

10060 - 821 Single Binary Input Accessor

Again, because the input of this device is arranged suitably only for I.S. inputs, the devices intended for connection to this accessor must be approved for connection to I.S. systems.

10058 - B24 Four Binary Input Accessor

Same comments as per B21 Accessor.

527 - 703 Pulse Accumulator Accessor D1

There is insufficient data associated with the schematic to know for certain where the input is located. However, it would be probably safe to say that this device can accept signals only from devices having outputs approved as I.S.

Also, with reference to note 1, we do not have a schematic for the D2 accessor. Please supply additional information regarding the implementation of these devices.

10210 Intrinsically Safe System Layout (2 Remote Trunk Driver Station)

The layout of the system is acceptable with the comment that any of the devices connected to the I.S. trunk must be either passive or have outputs approved for connection to I.S. systems.

10200 Assembly Drawing Explosion Proof Box

Both detail 1 and detail 2 are acceptable with the following notes: First, all exposed explosion proof components must be of non-aluminum construction, and a note to this effect should be put on the drawing. Also, the ½" conduit shown entering the explosion proof box indicates the use of a lock nut on the interior of this box. This detail is wrong, because the ½" conduit will have a tapered thread and will simply thread into the tapered hole of the explosion proof enclosure until tight. The thread should be specified as ½" NPT and a note should be made that at least five full threads be engaged for explosion proof integrity. The locknut detail ought to be removed to avoid manufacturing confusion.

10201 & 10198 Assembly Drawing; Battery Box

The preceeding notes apply to the battery box, also. What type of battery is to be used, (nickel cadmium, lead acid)? What would be the maximum expected output current of the batteries and what range will charging currents be within? If low enough, the battery box assembly can be treated as an I.S. assembly. If this is not possible, then suitable cautions need to be labelled on the unit, to the effect that the battery must be mounted in an area not subject to physical damage, is to be serviced by authorized personnel only, and is to be serviced only when safe (non-gassy) conditions prevail.

10195 - Explosion Proof Box Detail Drawing

Holes should be specified as NPT as applicable.

10194 - Sht. 1 of 2 of 2 Remote Trunk Driver Main Chassis

This unit, although it may have an I.S. output, must be located in a non-hazardous area.

10183 Sht. 1 of 2 DC Power Supply Assembly Drawing

Since this is for a non-I.S. power supply there is no comment.

10180 DC Power Supply Schematic

Same comment as for 10183.

10196 Wiring Diagram Remote Trunk Driver

The schematic we have for the accessor trunk driver card is 10134 and there is no identification on that drawing as being the P1163 card. Are they the same? What is needed is a visual inspection to observe I.S. - non-I.S. segregation methods and identifications.

A1052, A1053 DC Power Supply

Same comment as for 10183

A10174 Intrinsically Safe Power Supply Schematic

This unit was tested by us and found acceptable from a performance point of view (my letter dated May 26, 1982).

A1045, A1044, A1046 Intrinsically Safe Power Supply

Arrangement is acceptable, but a final visual inspection is required.

10178 - Assembly Drawing, Intrinsically Safe Power Supply

Markings must be prominent as to which is the I.S. output.

10067 & 10070 Modem Interface Schematic and Modern Interface Card

It is unclear as to what parts, if any, of this schematic are intended to be intrinsically safe. Judging from dwg. 10196 (remote trunk driver wiring diagram) the I.S. - non-I.S. interface does not occur here, and this card need not be considered for I.S.

Trunk Cable Submitted for Flame Testing

Please supply to us a description of the trunk cable that was submitted to us for vertical flame tests per CSA Standard C22.2 No. 0.3. Mr. McCullough dropped a sample of this cable off at our facilities for testing.

page........7

Inspection of System

I understand that Mr. R. Chakravorty of our Calgary office is interested in setting up a configuration of this system in our laboratory to prove it out and to train its operators/installers. At that time the necessary inspections could be done.

General Comments

There do not appear to be any serious departures from the philosophy of Intrinsic Safety.

It appears that a critical interface between the I.S. and non-I.S. circuits is the trunk driver unit, its associated wiring and installation, and we will be looking closely at this.

From the data that was submitted regarding the battery, it looks as though it may be possible to make it either I.S. or explosion proof. When we discussed battery boxes, non explosion proof boxes were, and still are, the norm for lead acid batteries. The construction of the battery box described in the drawings is suitable for a lead-acid type because this type outgasses during charge and discharge. However, the "gel-cel" type battery has been successfullly placed in an explosion proof box because it does not outgas. Alternatively, the non explosion proof enclosure could be used, but it may be possible to make it I.S. by limiting current to 1A in either direction. That is, the charger output would have an intrinsically safe output and the battery would be modified with current limiting resistors to provide an intrinsically safe output at its terminals. In any event, with this type of battery we feel it is feasible to upgrade the electrical safety of this component of the system.

The next step in the Certification process will be your replies to all the above comments. Also, at some point, we will want to make an inspection of the system, with the main emphasis on those aspects involving Intrinsic Safety.

Yours Truly,

G. Lobay, P.Eng.,
Investigating Officer, Electrical
and Diesel Flameproof
Canadian Explosive Atmospheres
Laboratory

GL/mmi

page........8

onspec

44 martin ross avenue, downsview, ontario M3J 2K8
telephone (416) 661-0500
telex 06-966710

October 5th, 1982.

Certification Officer
Building No. 9,
CANMET Bells Corner Complex,
Haanel Drive,
Ottawa, Ontario.

Attention: Mr. George Lobay

Subject: Intrinsic Safety of Senturion 200 System

Reference: C015-C55-1
Pr. No. 4.3.0.2.02.01

Dear Sir,

In response to your letter dated September 17th, 1982. I have updated and corrected our drawings to reflect the necessary changes as pointed out by yourself.

The attached list indicates the changes made to each drawing, as well as providing answers to the questions posed in your commentary.

Enclosed with this letter is a complete set of the drawings that have been updated, for your records and perusal prior to the physical inspection of the system, which will be on Thursday October 14th, at our plant in Toronto.

Should you require any further information please do not hesitate to contact me.

Yours truly,

M.H. Mohamed per ydr.
M.H. Mohamed
Encl:
MHM/ydr.
cc: J. Bossert
R. Chakravorty

LIST OF CORRECTIONS AND COMMENTS

10110, 10109, 10111

These drawings have been revised to remove the note "Flame proof enclosure must be located in a designated safe area", as t is inappropriate in this case.

Also the boundaries between hazardous and non-hazardous locations are indicated.

10024 - Octal Serial Converter

Your comments here are correct.

10134 - Accessor Trunk Driver

/3 The connector P2 is an IS connector, but is not intended for use when the system is installed. Its purpose is primarily for testing the card, as well as accessors on system startup. For I.S. applications use of this connector is not allowed, and no access is provided to this connector in the present packaging.

The purpose of R46 is to provide isolation for the capacitors used on the card. The 20V supply to the card is actually +15 Volts as supplied by the IS power supply.

The maximum breakdown voltage of the optical isolators used, the GE H11A1 is 1500 Volts DC continuous. A copy of the manufacturers data sheet is enclosed.

A copy of the artwork and schematic is enclosed. The closest over-board distance that the IS and NON-IS circuits have is 5mm (at the optical isolators).

The Part P1163 is the one that will be used for all IS circuits whether they are located at the surface or underground.

529-342 LD Accessor

This device has its track spacings at greater than 1mm t all the locations on the printed circuit board.

We do not at present have a unit of this type in our nventory, and inspection (as well as approval) by yourself ould have to be made at a later date.

A data sheet on the optical isolators used is enclosed.

10066 - Driver/Receiver Module

Your comments have been noted and are correct.

527-673 - B1 Accessor

Your comments here are correct, and a note has been dded to the device schematic and field wiring drawings to ndicate that the B1 contact Input may only be wired to pproved "dry" contacts that are intrinsically safe. Under o circumstances would they be wired to motor starters, nless the contacts are approved as intrinscally safe and ll the wiring to and from those contacts are correctly nstalled.

529-023 B2-Accessor

Again here a note to the effect that only approved I.S. evices may be connected to the accessor was added.

10144 Simplified Schematic of Trunk/Accessor Electrical Interface

No comment.

200-308 B25-Accessor Schematic

Note added. (See 529-023 above)

529-497 B20-B28 Accessor and Termination Board

This device is no longer being used on our system in he I.S. trunks. Its use will be restricted to the non-I.S. runks (if any) on a system.

The B20-Accessor is a 16-input device, whilst the 28-Accessor is only an 8-input device. Physically and lectrically the devices are identical, that is, the same rtworks and printed circuit boards are used. The difference s in the software at the central processor which only onitors either 8 or all 16 inputs depending on the manner n which the operator identifies it.

10060 - B21 - Single Binary Input Accessor

Notes added as per (527-673 above) Bl Accessor.

10058 - B24 Four Binary Input Accessor

Same as B21 above (10060)

10197 - Internal Assy - Remote Trunk Driver

Comments have been noted.

527-703 Pulse Accumulator

Your assumption regarding the input to the device is correct, in that only an approved I.S. "dry contact" device may be used.

The purpose of this device is to count the number of times a contact has opened or closed or both. Typical usage would be to interface to weigh transducers or power meters which provide pulse outputs. Other applications include counting the number of times a piece of equipment is started or stopped, or as batch counters.

The D2 accessor which is referenced in note 1 is no longer in use. This device was identical to the Dl device with the addition of a local display of the counter output.

10210 - I.S. System Layout

Comments have been noted.

10201 and 10198 Assy Drawings - Battery Box
10200 Assy Drawing Explosion Proof Box

Your comments are correct, and have been noted on our drawings.

10195 - Explosion Proof Box Detail Drawing

Notes added as per your comments.

10183
10180 DC Power Supply.
A1052
A1053

This power supply is a non-I.S. power supply whose output is preset to 27.6 Volts. This supply powers the intrinsically safe power supply (I.S. power supply).

The critical item - as far as this power supply is concerned is the AC transformer, which should be protective transformer type. A copy of the transformer specification is enclosed.

10196 - Wiring Diagram Remote Trunk Driver

Note the Trunk Driver card is P1163, the schematic of which is 10134.

10174, 10178, A1045, A1044, A1046 Intrinsically Safe Power Supply

Comments have been noted.

10067 and 10070 Modem Interface Card

Your comments are correct in that the I.S. - non I.S. interface does not occur on this card. It is included in the submittal because of the following:

(a) It connects to the trunk driver card and provides the drive for the optical isolators where the critical interface occurs.

(b) It is part of the remote trunk assembly.

List of Drawings as follows:

Dwg. No:	Rev:	Title:
10109	B	Typical System Layout - Configuration 1
10110	B	Typical System Layout - Configuration 2
10111	A	Typical System Layout - Configuration 3
10134	D	Accessor Trunk Driver Card Schematic
10202	A	Accessor Trunk Driver Card Assembly Drawing
527-673	F	B1 Accessor Schematic
529-023	D	B2 Accessor Schematic
200-308	F	B25 Accessor Schematic
10060	C	B21 Single Binary Input Accessor Schematic
10058	D	B24 Four Binary Input Accessor Schematic
10197	A	Internal Assembly Drawing - Remote Trunk Driver
527-703	H	D1 Pulse Accumulator Schematic
10210	A	I.S.System layout (2 Remote Trunk Driver Station)
10200	C	Explosion Proof Box - Assy - Dwg
10201	B	Battery Box - Assy - Dwg
10198 Sht 1	C	Battery Box - Detail Dwg
10198 Sht 2	0	Battery Box - Label
10195 Sht 1	B	Explosion Proof Box - Detail Dwg
10195 Sht 2	0	Explosion Proof Box - Label
10195 Sht 3	0	Explosion Proof Box - Frame
10180	B	DC Power Supply Schematic
10217	0	Hammond Transformer 120VAC/52VAC
10196	A	Remote Trunk Driver, Wiring Diagram
10067	C	Modem Interface Card, Schematic
10070	D	Modem Interface Card, Assy - Dwg
10194 Sht 1	C	Remote Trunk Driver, Main Chassis Detail
10194 Sht 2	C	Remote Trunk Driver, Door + Bracket Detail

APPENDIX H

CANMET CERTIFICATE OF APPROVAL FOR FINAL SYSTEM

Energy, Mines and
Resources Canada

Research and Technology

Canada Centre for Mineral
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555 Booth Street
Ottawa, Ontario
K1A 0G1

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Your file Votre référence

Our file Notre référence

C015-C55-1
Pr. No. 4.3.0.2.02.01

October 15, 1982.

CONSPEC,
44 Martin Ross Ave.,
Downsview, Ontario.
M3J 2K8

Attention: M.H. Mohamed

Dear Sir:

Subject: EMR Certification of Senturion 200 System for Intrinsic Safety

Please be advised that, subsequent to my inspection of the various components of the above system on October 14, 1982, that this system meets our requirements for Certification as an Intrinsically safe system for use on underground coal applications. We will be issuing the Certification documentation after an examination of schematics of transducers (CO and CH_4) incorporated with this system has been made. These transducers are made by others, but are certified by MSHA, so we do not foresee any problems with this last task that needs doing before Certification can be issued.

The CH_4 transducer has not been tested by us for performance and is evaluated for Intrinsic Safety only.

Yours Truly,

G. Lobay, P.Eng.,
Investigating Officer, Electrical
and Diesel Flameproof
Canadian Explosive Atmospheres
Laboratory

GL/mmi

Canadä

Energy, Mines and Resources Canada
Research and Technology
Canada Centre for Mineral and Energy Technology,
555 Booth Street
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Énergie, Mines et Ressources Canada
Recherche et technologie
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Telex: 053-3586

Your file Votre référence

Our file Notre référence
C015-C55-1
Pr. No. 4.3.0.2.02.01

January 10, 1983.

CONSPEC,
44 Martin Ross Ave.,
Downsview, Ontario.
M3J 2K8

Attention: Mr. M.H. Mohamed

Dear Sir:

Subject: Trunk Cable

Enclosed is Issue No. 2 of Schedule associated with Certificate No. 474 which covers the Accessor Trunk Cable. Please attach this to the Certificate. There is no fee for this service.

Yours Truly,

G. Lobay, P.Eng.,
Investigating Officer, Electrical
and Diesel Flameproof
Canadian Explosive Atmospheres
Laboratory

GL/mmi
encl. issue No. 2
of schedule

Canada

Energy, Mines and
Resources Canada

Research and Technology

Canada Centre for Mineral
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Your file *Votre référence*

Our file *Notre référence*

C015-C55-1
Pr. No. 4.3.0.2.02.01

JAN 25 1983

January 20, 1983.

Conspec Controls Inc.,
44 Martin Ross Ave.,
Downsview, Ontario.
M3J 2K8

Attention: Marty Hager

Dear Sir:

Subject: VM101B Methane Sensor, Model 5100 CO Sensor, VA216B Anemometer

The following will hopefully clarify our position regarding the above transducers and their use with the Conspec system.

VA216B Anemometer

J-Tec applied for and received our certificate No. 396 some years ago for their electronic anemometer. This means it can be connected to anybody's I.S. system including yours, as it is a "stand alone" type of certification. This transducer is also in the drawing schedule for the Conspec system which means it is also part of the Conspec system, and may therefore be used with it, as would be appropriate to the application at hand.

Model 5100 CO Sensor Mfd. by Energetics Science

This transducer was submitted to us as part of the Conspec system and is approved for use only in conjunction with the Conspec system, the reason being that Energetics Science has not made application to us for a "stand alone" type of certification such as was made for the J-Tec anemometer. Energetics Science could very easily obtain such a certification by making application to us.

...../2

Canada

Model VM101B Methane Sentor, Mfd. by J-Tec

There are two aspects to Certification of Methane transducers by EMR. The first is evaluation for electrical safety, involving usually the CSA Intrinsic Safety Spec., C22.2 No. 157, and the second aspect is performance assessment of the transducer insofar as detection of combustible gases in air is concerned. For coal applications this transducer meets our requirements for electrical safety but it has not been tested for performance. We cannot certify this unit on the basis of electrical safety only, as it would be inconsistent of us to do so, as well as unfair to the other companies who have had their instruments meet the requirements of both these specifications.

There is an exception to this. We will certify gas detection instruments for electrical safety only, if the instrument is being used by a Governmental Mining Research organization, such as our Mining Research Laboratory in Calgary, about which you know. The VM101B units in the possession of Dr. Chakravorty are covered under our Certificate No. 476 (copy of first page enclosed) and are certified on a "per serial number" basis. Also, note the disclaimer on the sheet relating to electrical safety only.

Therefore, if another Conspec system is being sold to CANMET the above can apply again, but the serial number of the VM101B units must be forwarded to us along with a letter of application.

For general certification, there is no alternative but to submit methane transducers to us for performance evaluation, a process which takes about 3 - 4 months. Having read U.S. Bureau of Mines Report RI8715 "Statistical Approach to the Analysis of Bias and Precision in Reusable Gas-Detecting Devices" in which performance assessment of a methane transducer apparently the same as the above was tested, and based on our own observations of results obtained with the sensor unit and with this transducer, the likelihood of compliance with CSA Spec. 152 is low. For a definitive answer, submit a transducer to us, and we will do a linearity check of the transducer to confirm what could be inferred above. This can be done relatively quickly.

Lastly, inclusion of Conspec drawing 10228 (J-Tec methanometer) in the general schedule of Certificate 474 is our error. Enclosed is Issue No. 3 associated with Certificate 474, correcting this error, for which we apologize.

Yours truly,

G. Lobay, P.Eng.,
Investigating Officer, Electrical
and Diesel Flameproof
Canadian Explosive Atmospheres
Laboratory

GL/mmi
encl. issue No. 3
schedule

Energy, Mines and Resources Canada
Énergie, Mines et Ressources Canada

Research and Technology
Recherche et technologie

Canada Centre for Mineral and Energy Technology,
555 Booth Street
Ottawa, Ontario
K1A 0G1

Centre canadien de la technologie des minéraux et de l'énergie,
555, rue Booth,
Ottawa (Ontario)
K1A 0G1

Your file Votre référence

Our file Notre référence

C015-C55-1

THIS CERTIFIES THAT
MINE MONITORING SYSTEM
"SENTURION 200"
MANUFACTURED BY
CONSPEC CONTROLS INC.,
44 MARTIN ROSS AVE.,
DOWNSVIEW, ONTARIO.
M3J 2K8

has been investigated by the Department of Energy, Mines and Resources, Canada, found to comply with CSA Standards C22.2 No.157-M1979 - "Intrinsically Safe and Non-Incendive Equipment For Use in Hazardous Locations", C22.2 No. 30 - "Explosion-Proof Equipment for Use in Hazardous Locations", and C22.2 No. 0.3 - "Test Methods for Electrical Wires and Cables", (all as applicable) and when constructed and implemented in accordance with the provisions of the associated schedule is suitable for use in underground coal mines.

John A. Bossert

Certificate No. 474
November 30, 1982.

John A. Bossert,
Certification Officer.

Canada

SCHEDULE

Associated with Energy, Mines and Resources, Canada, Certificate No. 474 dated November 30, 1982 and issued to Conspec Controls, Inc., Downsview, Ontario.

Issue No. 1
November 30, 1982.

Installation of Mine Monitoring Systems

In order that the many components constituting a mine monitoring system be implemented in a safe manner, the provisions of Appendix F of the Canadian Electrical Code, CSA Standard C22.1-1982 "Recommended Installation Practice for Intrinsically Safe Electrical Equipment and Wiring" need to be observed as a guide to the installation of this system.

System Configuration

The approved general system configurations are shown in the drawing list, and the system implementation must conform to these configurations. Fundamental variations from these approved system configurations may defeat the intrinsic safety of the system.

Telephone Lines

It should be noted that telephone lines to which this system may be connected for communication purposes are **not considered to be intrinsically** safe and should therefore be accorded the normal wiring methods for non-intrinsically safe installations in hazardous locations, including precautions for segregation between Intrinsically Safe and non-Intrinsically Safe wiring.

Connection to Transducers and Other Peripheral Devices

This mine monitoring system may be connected to transducers and other peripheral devices. These devices must be EMR certified if they are "active" devices; i.e., devices which require connection to a power source for operation (obtained from the monitoring system itself or from an external supply) or if they contain energy storage devices such as capacitors, relay coils, or other inductors. Approval need not be sought for connection to this system of passive devices such as switches, resistors or other non-energy storage devices although the Installation Practices of the Canadian Electrical Code Part 2, Appendix F (see above) are applicable to these and all devices connected to this system.

Battery Box

This system may use standby battery power to assure system integrity in the event of power outages. Battery boxes for this purpose may be installed underground. Because the batteries may produce some quantities of potentially explosive gases in normal use, the enclosures in which they are housed are ventilated to quickly dilute this gas to non-explosive concentrations. This is a normal practice for battery boxes in hazardous locations. All servicing of the battery unit must be done in a non-hazardous location. In order to replace the battery, the unit has to be physically disconnected and removed from its mounting location to the surface or an approved non-hazardous location. It is not physically possible to remove the batteries unless there is access to both the front and back of the P1188 mounting frame. This unit must also be located in an area where it will not be subject to physical abuse, and where the occurrence of concentrations of methane is known to be low.

Drawing List

The certified apparatus is constructed in accordance with the following drawings:

Drawing No.	Description	Rev.
102102	I.S. system layout (2 remote trunk driver station)	A
10109	Configuration one	2
10110	Configuration two	2
10111	Configuration three	0
10134	Schematic diagram - accessor trunk driver card	D
10202	Assembly drawing - accessor trunk driver card	A
527-673	Schematic diagram - B1 accessor	F
529-023-R4	Schematic diagram - B2 accessor	4
200-308	Schematic diagram - B25 accessor	F
10060	Schematic diagram - B21 accessor	3
10058	Schematic diagram - B24 accessor	4
10197	Internal assemly drawing remote trunk driver	B
527-703	Schematic diagram - pulse accumulator accessor D1	8
10200	Assembly drawing - explosion proof box cable fitting	C
10201	Assembly drawing - battery box	B
10198 Sht. 1 of 2	Detail drawing - battery box and clamp set	C
10198 Sht. 2 of 2	Label for battery box	-
10195 Sht. 1 of 3	Detail drawing - explosion-proof box	B
10195 Sht. 2 of 3	Label for remote trunk driver unit	-
10195 Sht. 3 of 3	Detail drawing - mounting frame for I.S. remote trunk driver assembly	-
10180	Schematic diagram DC power supply	B
10217	Schematic diagram & assembly drawing for Hammond transformer 120 VAC/52VAC	
10196	I.S. Remote trunk driver C/W battery backup	B
10067	Schematic diagram - modem interface	C
10070	Assembly drawing - modem interface card	-

Drawing No.	Description	Rev.
10194 Sht. 1 of 2	Detail drawing - main chassis remote trunk driver	D
10194 Sht. 2 of 2	Detail drawing - door & bracket remote trunk driver	D
10175	Schematic diagram, basic analog input accessor, A49-A61	B
A1040	Artwork, A49-A59 analog accessor	-
A1041	Silkscreen, analog accessor A49-A59	-
10187	Assembly drawing, 0-1V, 0-1mA A50 analog accessor	-
10188	Assembly drawing, 0-10V, A51 analog accessor	-
10189	Assembly drawing, 0-5mA, A52 analog accessor	-
10190	Assembly drawing, 0-20mA, A53 analog accessor	-
10186	Assembly drawing, 1-5V, A54 analog accessor	-
10176	Assembly drawing, 0-5V, A55 analog accessor	-
10177	Assembly drawing, 4-20mA, A56 analog accessor	-
10181	Assembly drawing, A57 analog accessor	-
10185	Assembly drawing, 0.2-1.0V, A58 analog accessor	-
10182	Assembly drawing, 1.0-0V or 1.0-0mA (negative slope) A59 analog accessor	-
101222	Assembly drawing, A60 analog accessor	-
10226	Assembly drawing, 0.5V-1.5V, A61 analog accessor	-
10223	Schematic diagram, basic analog RTD accessor, A63, A64, A67	-
10224	Assembly drawing, analog RTD accessor, A63, A64, A67	-
10227	Wiring diagram & assembly drawing for J-TEC anemometer	-
10228	Wiring diagram & assembly drawing for J-TEC methanometer	-
10229	Wiring diagram & assembly drawing for CO diffusion monitor assembly	-
10231	Accessor trunk splitter box	-

C015-C55-1

SCHEDULE

Associated with Energy, Mines and Resources, Canada, Certificate No. 474 dated November 10, 1982 and issued to Conspec Controls Inc., Downsview, Ontario.

Issue No. 2
December 23, 1982.

All of Issue No. 1 associated with the above certificate remains valid, in addition to the following:

Trunk Cable, manufactured by Mercury Wire, P/N 2389; Conspec Part No. P1209.

SCHEDULE

Associated with Energy, Mines and Resources, Canada, Certificate No. 474 dated November 10, 1982 and issued to Conspec Controls Inc., Downsview, Ontario.

Issue No. 2
December 23, 1982.

All of Issue No. 1 associated with the above certificate remains valid, in addition to the following:

Trunk Cable, manufactured by Mercury Wire, P/N 2389; Conspec Part No. P1209.

Issue No. 3
January 17, 1983

All of Issues Nos. 1 and 2 associated with the above certificate remain valid, with the following change:

Delete CONSPEC drawing No. 10228 from Issue No. 1

Energy, Mines and Resources Canada
Research and Technology
Canada Centre for Mineral and Energy Technology,
555 Booth Street
Ottawa, Ontario
K1A 0G1

Energie, Mines et Ressources Canada
Recherche et technologie
Centre canadien de la technologie des mineraux et de l'energie,
555, rue Booth,
Ottawa (Ontario)
K1A 0G1

Your file Votre référence

Our file Notre référence

C015-M1-43

THIS CERTIFIES THAT
METHANE MONITORING UNITS
INTENDED FOR CONNECTION TO DATA ACQUISITION SYSTEMS
TYPE VM101B
SERIAL NUMBERS
C82.033, C82.028, and C82.027
MANUFACTURED BY
J-TEC ASSOCIATES,
CEDAR RAPIDS,
IOWA, U.S.A.
SUBMITTED BY
CANADA DEPARTMENT OF ENERGY, MINES AND RESOURCES,
MINING RESEARCH LABORATORIES,
CALGARY, ALBERTA.

has been investigated by the Department of Energy, Mines and Resources and when constructed in accordance with the Schedule associated with this certificate, has been found to meet the requirements of CSA Standard C22.2 No. 157-1979 "Intrinsically Safe and Non-Incendive Equipment for Use in Hazardous Locations" and is therefore suitable insofar as electrical safety is concerned only, for use in coal mines.

It is understood that no minimum performance level insofar as detection and indication of methane gas by this apparatus can be inferred as a result of the issuance of this certificate, which relates to electrical safety only. This certificate covers only those units bearing the serial numbers cited above and is issued so that the certified apparatus may be used for research purposes only.

ORIGINAL SIGNED BY
ORIGINAL SIGNÉ PAR
J. A. BOSSERT

Certificate No. 476
December 7, 1982.

John A. Bossert,
Certification Officer

Canada

S C H E D U L E

Associated with Energy, Mines and Resources, Canada, Certificate No. 474 dated November 10, 1983, and issued to Conspec Controls Inc., Downsview, Ontario.

Issue No. 4
July 28, 1983.

All of Issues Nos. 1, 2, and 3 associated with the above certificate remain valid. In addition, the drawings listed herein describe EMR Certified acceptable changes to the Conspec Senturion 200 system, and, where such changes are implemented, the certified apparatus must be constructed in accordance with these drawings and specifications.

In summary, this Schedule Issue allows for:

1) A new power circuit barrier, P1224.
2) A new I.S. barrier, P1225.
3) A new communications barrier, P1323.
4) A new mine portal barrier, P1325.
5) Minor circuit changes to accessors and transducers, as specified in the drawings.
6) Inclusion of the Sieger BM1 methane monitor with the Conspec Senturion 200 system.
7) Inclusion of a carbon monoxide monitor manufactured by Mine Safety Appliances Co.

Additional Conditions of Certification

Power Barrier, P1224, Drawing 10235

The above barrier does not provide an intrinsically safe output and must always be used in conjunction with the I.S. Barrier, P1225, which does provide an Intrinsically Safe output.

Drawing No.	Description	Rev.
10235	Power barrier for accessor trunk	B
10236	Accessor trunk I.S. barrier	B
10298	Schematic diagram, communication barrier	0
10299	Assembly drawing, communication barrier	0
A1080	Artwork, communication barrier	0
A1082	Silkscreen, label, communication barrier	0

Drawing No.	Description	Rev.
10210	Intrinsically safe system layout (2 remote trunk driver station)	B
10196	I.S. Remote trunk driver c/w Battery Backup Wiring diagram	E
10197	I.S. Remote trunk driver c/w Battery Backup, Internal assembly	C
10202	Schematic diagram; 2-wire surge protection/barrier for mine portal	0
10175	Schematic diagram; analog input accessors A49 and up	F
10175	Schematic diagram; analog input accessor A49 and up	E
10223	Analog RTD accessor; A63, A64, A67, schematic diagram	B
10066	Schematic and assembly; driver/receiver module	D
10230	A49 analog accessor assembly	B
10187	A50 analog accessor assembly	B
10188	A51 analog accessor assembly	B
10189	A52 analog accessor assembly	B
10190	A53 analog accessor assembly	B
10186	A54 analog accessor assembly	B
10176	A55 analog accessor assembly	B
10177	A56 analog accessor assembly	B
10181	A57 analog accessor assembly	B
10185	A58 analog accessor assembly	B
10182	A59 analog accessor assembly	B
10222	A60 analog accessor assembly	B
10226	A61 analog accessor assembly	B
10258	A62 analog accessor assembly	0

Drawing No.	Description	Rev.
10259	A65 analog accessor assembly	0
10260	A66 analog accessor assembly	0
10261	A68 analog accessor assembly	0
10262	A69 analog accessor assembly	0
10295	A72 analog accessor assembly	0
10327	A82 analog accessor assembly	0
10316 sht. 1 of 2	Field wiring diagram for 0-3% methane monitor	0
20316 sht. 2 of 2	Field wiring diagram for 0-3% methane monitor	0
10303	Wiring and assy. dwg. CO diffusion monitor (MSA)	0
CSK3046-80	CO sensor for USBM (modified)	0
DDC0338	Schematic diagram - circuit card, airflow	D

Energy, Mines and Resources Canada
Énergie, Mines et Ressources Canada

Research and Technology
Recherche et Technologie

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Ottawa, Canada
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Our file Notre référence

AUG 18 1983

C015-M1-43

THIS CERTIFIES THAT
INTRINSICALLY SAFE METHANE MONITORING UNITS
INTENDED FOR CONNECTION TO DATA ACQUISITION SYSTEMS
TYPE VM101B
WITH SERIAL NUMBERS
AS SPECIFIED IN THE ASSOCIATED SCHEDULE
MANUFACTURED BY
J-TEC ASSOCIATES,
CEDAR RAPIDS,
IOWA, U.S.A.
SUBMITTED BY
CANADA DEPARTMENT OF ENERGY, MINES AND RESOURCES,
MINING RESEARCH LABORATORIES,
CALGARY, ALBERTA.

has been investigated by the Department of Energy, Mines and Resources and when constructed in accordance with the Schedule associated with this certificate, has been found to meet the requirements of CSA Standard C22.2 No. 157-1979 "Intrinsically Safe and Non-Incendive Equipment for Use in Hazardous Locations" and is therefore suitable insofar as electrical safety is concerned only, for use in coal mines.

It is understood that no minimum performance level insofar as detection and indication of methane gas by this apparatus can be inferred as a result of the issuance of this certificate, which relates to electrical safety only. This certificate covers only those units bearing the serial numbers cited above and is issued so that the certified apparatus may be used for research purposes only.

John A. Bossert.

Certificate No. 476
December 7, 1982.

John A. Bossert,
Certification Officer

Canada

C015-M1-43

SCHEDULE

Associated with Energy, Mines and Resources, Canada, Certificate No. 476 dated December 7, 1982 and issued to the Department of Energy, Mines and Resources, Mining Research Laboratories, Calgary Alberta.

Issue No. 1
December 7, 1982.

The certified apparatus is constructed in accordance with the following drawing:

Drawing No.	Description	Rev.
DDC0339	Schematic diagram - circuit card, methane	A

This certificate applies only to those instruments bearing serial numbers listed as follows:

C82.033
C82.028
C82.027
C82.026
C82.032